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THE KLONDIKE GOLD FIELDS.

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KLONDIKE is a word found neither in dictionary nor gazetteer, and you will look in vain for it in the latest

wait for it. They are already on their way to the new country to "stake out" claims, thaw the frozen gravel, dig masses of earth, and "pan out" the "dust." The trail, we are told, is strewn with the bodies of the victims of the craze; and many of the miners who un-

The greed of the Spaniards of Pizarro's day for the shining metal was no greater than that which was manifested in the wild rush for California and Australia nearly half a century ago. The news of gold discovery seems to have the power of creating a fever in the



DEPARTURE OF THE "EXCELSIOR," BOUND FOR ST. MICHAELS, CARRYING GOLD SEEKERS.

atlases. A few weeks ago nobody except a few whites and Indians had ever heard of it; now who is there who has not had it on his tongue many times? It has quickly become a magical name, and at its mention golden visions enchant the imagination, and big yellow nuggets and bags of shining dust seem actually to strain the muscles of the hand. The map makers must be diligent and give the world a chart of the new Eldorado. The greedy gold hunters will not, however,

covered sudden riches are themselves covered by the soil in which they found the wealth they were never to enjoy.

But crowds will go after gold, anywhere, everywhere, at any cost of suffering and deprivation. They will dig and starve, and even die, amid equatorial heats or polar snows for a handful of yellow earth.

"Gold many hunted, sweat and bled for gold,
Waked all the night and labored all the day."

blood, and men, and, in these latter days, women as well, hurry off at mad speed to have their chance, often a very slim one, at fortune.

Where is Klondike? The map given herewith, made from the latest chart prepared by our government, shows that it is in the Queen's dominions, close to the border of our Alaskan possessions. It is in the Northwest Territory, and is, of course, under Canadian control.

It will be observed that it is quite close to the Arctic Circle, whence it may be inferred that its winters, if not its summers, are apt to be rigorous. The summers, beginning in May, are about four months long, and the sun, notwithstanding the high latitude, warms up the atmosphere so thoroughly that sometimes the thermometer climbs above ninety. But surely the nights must be cool, for the gravel, we are told, is frozen down to bed-rock, twenty or twenty-five feet. They might be, if there were any; but for months the people of that region never lose sight of the sun, and at midnight, if it is proper to use such a term, it is almost as light as at noonday.

The country is not entirely barren. Parts of it grow a species of pine which attains a size suitable for boards

the border in our own Territory of Alaska. There are paying mines at Circle City on the Yukon, at Forty Mile, at the junction of Forty Mile Creek with the Yukon, and probably on other streams to the south.

The discovery of the wonderful deposits in the Klondike region appears to have been made in August, a year ago, by George Carmack. Evidently he was not succeeding at "Forty Mile," which is on the Yukon, in Alaska, and strolled across the border on a prospecting tour. He found gold in paying quantities near the junction of the Bonanza and Klondike Creeks, and returned to Forty Mile for help. With two Indians he was able to "pan out" about \$500 a week. The news was slow in reaching Circle City, a large camp of miners about two hundred miles lower down on the

lowest stratum was lined with gold dust and nuggets. The rock was full of V shaped seams, and every seam contained a clay rich with gold. One of the miners had his wife with him, and she carried gravel to their hut by the pailful, and washed it. She took out on her own account \$6,000 during the winter. Another woman, not oppressed with household cares or the demands of society, picked up several thousand dollars' worth of nuggets on the dumps—a nice little sum of pin money. Four young men cleaned up \$49,000, and a Michigan man, with a few helpers, made \$94,000 out of his winter's work. But he had a hard time of it at first. He settled on the Klondike alone. For a place to sleep and keep his provisions he dug a hole in the ground. Every day he tramped about vainly looking for gold. His back was a mass of sores from the heavy pack he carried, and his feet were frozen and blistered. For six weeks he did not see one of his own kind. One day he found a little stream flowing down the mountain side and emptying into a basin. The water was only partly frozen. It was shallow, and at the bottom his aching eyes suddenly caught the gleam of gold. Leaping into the icy water, he began to snatch up the golden nuggets. He worked with wild excitement, and carried the gold to his hut, where he buried it for fear of thieves. He toiled this way until spring and had his fortune. Everybody got gold. If they had no claim and no money to buy one, they got work at from \$15 a day up to \$50; for labor was scarce. A young man "panned out" \$40,000 in two days. Almost every miner got a fortune. Nearly all were poor when they went there, but many came away rich. A deck watchman on one of the river steamers spent a few months on the Klondike, and came to San Francisco with \$150,000.

These stories, which seem fabulous, are known to be true. The gold has been brought back and put in banks and assay offices and with trust companies. The miners brought it in carpet bags, sacks, oil cans, old tomato cans, boxes, belts and other queer receptacles. It is estimated that \$3,000,000 was taken out in the Yukon district in 1895, nearly \$5,000,000 in 1896 and that the yield for 1897 will be over \$10,000,000.

The mines are what are known as placer mines, and gold is obtained in the form of dust and nuggets. The largest nugget found so far was worth about \$250 and was about the size of an ordinary potato. This is small compared with the nuggets found in Australia and California. The Victorian mines produced a single mass of gold worth \$41,000 and weighing 146 pounds avoirdupois, while California broke the record with a lump weighing 186 pounds. California gold is richer than the Klondike metal, having a smaller percentage of silver, lead and other metals. It is the quantities that Klondike yields that makes it one of the most famous gold regions known to the world. Another remarkable feature of the new Eldorado is that none of the claims worked so far has proved a blank. The best claims are those on the Klondike, which empties into the Yukon, the Bonanza, a tributary of the Klondike, and the Eldorado, which flows into the Bonanza. The gold region is believed to embrace Circle City and Forty Mile, Alaska, and the Klondike region south to Stewart River; and it is reasonably certain that we shall yet have large mineral wealth from our Alaskan territory to compensate us for the gradual loss of the fur seal industry.

The great question since the discoveries has been how to get to Klondike. The stream of travel follows two routes principally. Taking steamer at Seattle, Washington, Vancouver or Victoria, British Columbia, you go west to the southwestern extension of Alaska, passing from the Pacific Ocean through Unimak Strait into Bering Sea, and thence to St. Michael Island, some ninety miles above the mouth of the Yukon. There are light draught river steamers which will take you up the Yukon to the gold fields, distant about 2,000 miles. Counting the sea voyage from Seattle to St. Michael, 3,500 miles, makes the gold region some 5,500 miles away by this route. Another route, shorter by at least 2,500 miles, is by steamer from Seattle or Tacoma to Sitka, thence to Juneau and to Dyea, which is on Chilkoot Inlet, at the foot of Chilkoot Pass. From Chilkoot Pass to the Klondike it is about 600 miles. Crossing the mountains is a difficult and hazardous feat. To get over the pass requires an ascent of 4,000 feet, and much of the rise is so precipitous that a single misstep may mean sudden destruction. From the pass the way lies through a chain of five lakes—Lindemann, Bennett, Tagish, Marsh and Labarge—and thence to the head waters of the Yukon. Part of this hard journey is overland, and has frequently to be made through melting snows. Dangerous cataracts are encountered in the boat passage on the lakes, and many wrecks bear witness to the necessity of skillful piloting down the swift currents to Miles Canon and the White Horse Rapids,



and building purposes, and there is a small sawmill at Dawson City to turn out materials for houses. We are also told that miners have had some success in planting gardens. There is little or no game, however, and there does not seem to be an abundant supply of fish in the numerous streams. The Klondike, they tell us, signifies to the Indian "plenty of fish." There is nothing to sustain life except the supplies, mostly of canned goods, which are brought from the towns of British Columbia or of the United States; and since the great rush of prospectors to these valleys, rich only in mineral wealth, food has commanded enormous prices. No article is sold for less than fifty cents, and a bag of flour or a peck of potatoes is sometimes considered a fair equivalent for several ounces of gold.

The Klondike is one of a number of creeks which empty into the Yukon, and gold is found in the gravel deposits which form the valleys through which these streams run. The richest finds have been on the Klondike and the Bonanza; but claims have been laid out also on Dominion, Indian, Hunter, Glacier, Miller, Eldorado and Gold Bottom Creeks. This is nearly all in British territory. But we have gold fields just across

Yukon. Perhaps they did not believe the first reports. At all events, it was December before any movement was made. Then in one day Circle City was depopulated and a new city, Dawson, was established at the mouth of the Klondike, on the Yukon. There was a mad rush for the new country. Immediately it was all staked out. Along every stream and in every gulch claims were marked off, and with feverish haste the work of thawing the gravel was begun. There was then no water to wash the dirt with; but they could not wait for summer to loose the streams, so some of them made "rockers" and tunneled and "rocked" the earth and found it full of gold.

The stories of how gold was taken in winter and the present summer everybody has read. One man worked a hundred feet of his claim, took out \$100,000, refused \$200,000 for the rest of it, and started for California. He got as much as \$212 from one pan of dirt. He washed out, on the average, \$250 an hour. Two men took out \$6,000 in one day. Some made no attempt to work their claims, but sold them for moderate fortunes. One miner, who dug down to bed-rock, found that the



ON THE SUMMIT OF CHILKOOT PASS.

frequently called "the Miner's Grave." This, being a third shorter than the St. Michael route, is selected by ninety out of every hundred miners, notwithstanding its great hardships and perils, for they are naturally in a hurry to get at the nuggets.

Still another way of reaching Klondike is over the White Pass, from Juneau. Ocean steamers can land at the foot of the pass on Skaguay Bay, about eighty-five miles from Juneau. The pass is not difficult. It is 1,000 feet lower than Chilkoot, and it is in contemplation to build a railroad over it to Teslin Lake, a distance of only about thirty-five miles. Light draught steamers will run from Teslin Lake to Grand Canon, around which a road may be built. From the foot of the canon steamers may easily reach all the mining settlements. Within a few months this route will probably be the favorite one, and, of course, a telegraph line will connect Dawson City with the rest of the world at an even earlier date.

And so a trip to the Klondike gold fields may soon be an ordinary vacation tour. For gold is wealth, and wealth men covet, and think no enterprise too great or hazardous to get it. But at present it is no vacation tour; and the hazard is so great that only the strongest and the best equipped should risk starving or freezing to death.

For the article and map we are indebted to the Independent and for our illustrations to the Wave, of San Francisco, Cal.

THE TURANIAN OR ARAL TIGER IN THE ZOOLOGICAL GARDENS AT BERLIN, GERMANY.

THE Berlin Zoological Gardens have for some time endeavored to bring before the public geographical va-

Hagenbeek, who imported the animals, asserts that not only the Persian tiger, but also the Persian lion is thus distinguished, and he intends to prove the truth of his assertions by further importation. Scientific literature seems to offer some indications showing that the fossil tiger of the Siwalik Hills (*Felis cristata*) was similarly flat faced.

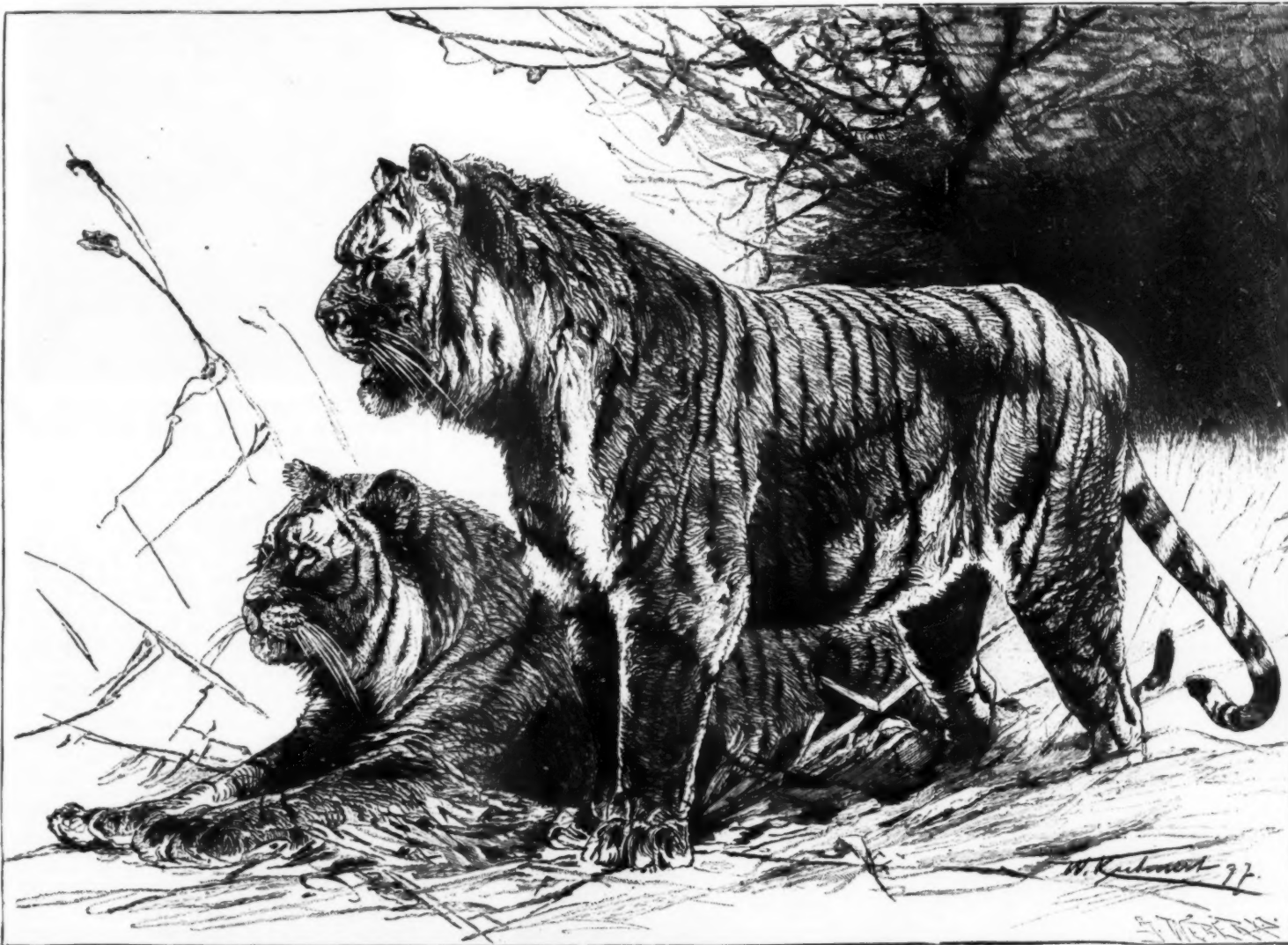
Little is known about the new inhabitants of the Berlin Zoological Gardens, except that they reached their present abode via Tiflis, and that probably they are natives of the Aral-Caspian region. A comparison of the animals with some furs obtained by Von Humboldt in those parts, and presented to the Berlin Museum, seems to justify this supposition. Of other zoological institutions, that of St. Petersburg, with its rich stock of Asiatic curiosities, is the only one that is likely to be able to furnish any parallel to these Aral tigers. The appearance of these, and a pamphlet published about them by Mr. Matchie, has created some sensation among zoologists and paleontologists, as supplying some clew in the long debated question on the cave lion and the cave tiger, the remains of which are often found in diluvial strata of Wurtemberg and other places. For our engraving and the foregoing description we are indebted to the *Illustrirte Zeitung*.

THE BRITISH ASSOCIATION—ADDRESS IN GEOLOGY.

THE address in Section C was delivered by Prof. G. M. Dawson, C.M.G., F.R.S., who said: The nature and relations of the more ancient rocks of North America are problems particularly Canadian, for these rocks are in typical and most easily read development either constitute or border upon the Continental Protaxis of the north. The questions involved are, however, at

separated from those of the Huronian and Laurentian systems. In attempting to review so wide a subject, and one upon which so much has already been written, the chief difficulty is to determine how much may be legitimately eliminated while still retaining the important features. This must be largely a matter of individual judgment, and I can only hope to present what appear to me to be the essential points, with special reference to the geology of Canada. The useful object of any such review is, of course, to bring out what may now actually be regarded as established respecting these older rocks, and in what direction the most hopeful outlook exists for improving our knowledge of them. For this purpose, the best mode of approaching the subject in the first place, and up to a certain point, is the historical one; and it will thus be desirable to recapitulate briefly the first steps made in the classification of the crystalline schists in Canada.

Having done that, Dr. Dawson concluded: In thus rapidly tracing out what appears to me to be the leading thread of the history of the pre-Cambrian rocks of Canada, and in endeavoring to indicate the present condition of their classification, and to vindicate the substantial accuracy of the successive steps taken in its elaboration, many names and alternative systems of arrangement proposed at different times, by more or less competent authorities, have been passed without mention. It has also been my object, in so far as possible, by omitting special reference to divergent views, to avoid a controversial attitude, particularly in respect to matters which are still in the arena of active discussion, and in regard to which many points remain admittedly subject to modification or change of statement. But, in conclusion, and from the point of view of Canadian geology, it is necessary to refer—even at the risk of appearing controversial—to the compara-



THE TURANIAN TIGER AT THE BERLIN ZOOLOGICAL GARDENS.

rieties of the same species. Thus, for instance, in the case of the tiger, the visitor is shown the great Bengal tiger, a giant in his kind, with short fur, of light color, the dark stripes fairly wide apart; then the Sunda tiger, as found in Malacca and the great Sunda Islands, much smaller than his Bengal relative, of low stature, dark color, and close striped, long fur. He has a bushy beard and often rudiments of a mane. Then, again, there is the Siberian tiger, from the valley of the Amoor River. He resembles the Bengal tiger in his massive body, but differs widely from him in his soft woolly coat and his arm-thick tail.

Quite recently the gardens have received a most interesting addition to their stock in a pair of Turanian or Aral tigers. These are altogether a novelty. There we have the color and the marking of a tiger, but not a tiger's build. The body is comparatively short and deep. The head, particularly of the male, is so short that one is almost inclined to believe that this is a case of accidental deformity. The thick, long coat, which is almost shaggy in some regions, somewhat obliterates the marks, such as the tiger of the tropics shows them. Similarly, the stripes on the tail are somewhat indistinct and irregular. The short mane and the pointed beard forcibly remind us of the Sunda tiger.

Regarding the peculiar formation of the face, Herr

the same time, perhaps, more intimately connected with a certain class of worldwide geological phenomena than any of those relating to later formations, in which a greater degree of differentiation occurred as time advanced. A reasonably satisfactory classification of the crystalline rocks beneath those designated as Palaeozoic was first worked out in the Canadian region by Logan and his colleagues—a classification of which the validity was soon after generally recognized. The greatest known connected area of such rocks is embraced within the borders of Canada; and if I mistake not, the further understanding of the origin and character of these rocks is likely to depend very largely upon work now in progress or remaining to be accomplished here. Although it is intended to speak chiefly of the distinctively pre-Cambrian rocks of Canada, and more particularly of the crystalline schists, it will be necessary also to allude to others, in regard to the systematic position of which differences of opinion exist. Of the Cambrian itself, as distinguished by organic remains, little need be said; but it is essential to keep in touch with the paleontologically established landmarks on this side, if for no other reason than to enable us to realize in some measure the vast lapse of time, constituting probably one of the most important breaks in geological history, by which the Cambrian and its allied rocks are

tively recent attempt to introduce an "Algonkian System," under which it is proposed to include all recognizable sedimentary formations below the Olenellus zone, assumed for this purpose to be the base of the Cambrian. If in what has already been said I have been able correctly to represent the main facts of the case—and it has been my endeavor to do so—it must be obvious that the adoption of such a "system" is a retrograde step, wholly opposed, not only to the historical basis of progress in classification, but also to the natural conditions upon which any taxonomic scheme should be based. It not only detaches from the palaeozoic great masses of conformable and fossiliferous strata beneath an arbitrary plane, but it unites these, under a common systematic name, with other vast series of rocks, now generally in a crystalline condition, and includes, as a mere interlude, what, in the region of the Protaxis at least, is one of the greatest gaps known to geological history. In this region it is made to contain the Keweenaw, the Animikie, the Huronian, and the Grenville series, and that without in the least degree removing the difficulty found in defining the base of the last mentioned series. It thus practically expunges the result of much good work, conducted along legitimate lines of advance during many previous years, with only the more than doubtful advantage of ena-

bling the grouping together of many widely separated terranes in other districts where the relations have not been even proximately ascertained. It is, in effect, to my mind, to constitute for geology what was known to the scholastic theologians of a former age as a limbo, appropriate as the abode of unjudged souls and unbaptized infants, that might well in this case be characterized as "a limbo large and broad." It is not intended to deny that there may be ample room for the introduction of a new system, or perhaps, indeed, of an entire geological æon between the Huronian, as we know it in Canada, and the lowest beds which may reasonably be considered as attaching to the Cambrian, or even to the Paleozoic as a whole. On the contrary, what has already been said will, I think, show that in the region of the Protaxis we might very reasonably speak of an "Algonkian hiatus," if we elect so to call it. Elsewhere it will undoubtedly be possible, sooner or later, to designate series of rocks laid down during the time represented only by orogenic movements and vast denudation in the province here more particularly referred to, but before any general systematic name is applied to such terranes they should be defined, and that in such a way as to exclude systems already established as the result of honest work.

THE MOUNT ETNA OBSERVATORY.

ETNA, the largest volcano of Europe, in the form of an imposing isolated cone, one and three-quarter miles in height and eighteen miles wide at the base, is situated upon the eastern coast of Sicily, eighteen miles to the north of Catania. Its summit nearly touches the limit of perpetual snow, and, consequently, in all seasons except summer, the upper portion of the mountain is covered with a mantle of snow of greater or less extent, and the temperature is very cold there. At the bottom, on the contrary, the climate is mild, and there is a varied and luxuriant vegetation consisting of spe-

the snow from the burning heat of the lava at a temperature of 1,000°, so that the latter may not flow over the snow without melting it, except in small quantity. This was observed in the eruption of 1879. This pro-

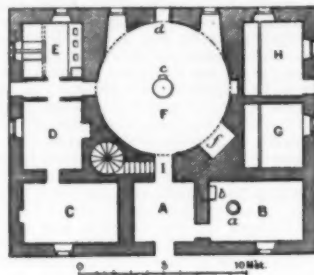


FIG. 1.—Ground Floor Plan of the Etna Observatory: A. Entrance. B. Geodynamics: a, tromometer; b, seismoscopes. C D. Alpine lodgings. E. Kitchen. F. Hall: c, seismic clock. G H. Stable. 1. Stairway to the first story. First Story: F. Refractor room. D. Meteorological window: photography. E. Keeper. E. Workshop. G. Bedroom. H. Second room.

ective or isolating action of the volcanic products has an important industrial application in the commerce of the snow that is preserved, either naturally in the ancient extinct eruptive material or in the artificial trenches that are covered with volcanic sand.

From the summit of Etna there is a superb view of 120 miles radius over almost the whole of Sicily, Malta

ests, vineyards and fields that it meets with in its fatal flow of several miles. Usually, from the summit of Etna, it is possible to follow these grand phenomena, which develop beneath the feet of the observer.

The utility and interest of placing a refuge for visitors and a station for special geological, seismological and geophysical studies upon the summit may be readily seen.

M. Riccio, the learned director of the two observatories of Catania and Etna, who has published such fine works upon this establishment and upon the meteorology of this region, has been kind enough to send us the photographs that illustrate the following note by M. H. Faye, the illustrious dean of French astronomers.

This observatory, says M. Faye, was constructed according to the ideas of Prof. Tacchini, in view of special researches without continuity. It was restored in 1891, after disasters caused by the elements and the eruption of 1886. At present there are in place an equatorial of 18 ft. focal length and various meteorological and seismological instruments. Observations are made here regularly, save in winter, the epoch at which eruptions are inevitable.

This year either a telegraph or telephone line will be run at least as far as to Nicolosi, and this will permit of rendering the work regular. The spot is reached from Catania by a road passable for vehicles as far as to Nicolosi (2,300 ft.), and by mule road up to



FIG. 2.—ALPINE METEOROLOGICAL STATION HALF WAY BETWEEN NICOLOSI AND THE ETNA OBSERVATORY.

cies belonging to both subtropical and cold countries. In fact, in ascending, we met with cactuses, orange and olive trees, grapevines, wheat, chestnut trees, pines, ferns, etc., up to 6,500 ft., after which there is nothing but rocks, volcanic sand and snow. The foot of Etna is one of the most picturesque of regions, and one of the most fertile and populous in the world, despite the threatenings and dangers of the volcano. In the highest part the snow and hail are in perpetual contrast with the heat and fire of the volcano. Usually, the burning materials ejected by Etna melt the snow. Thus, in the winter and spring of 1893, the craters and the lava of the eruption of 1893, that is to say, several months after their cooling, were seen standing out in dark relief against the white background of snow that covered the mountain.

But it requires a stratum of volcanic ashes to protect

and the Æolian Islands, because the air, reduced to nearly a third of its density, is of extreme transparency.

Etna has long periods of calm, during which the abundant eruptions of steam are rare, and the earth, even near the central crater, at the observatory, is entirely quiet, and does not disturb the most sensitive seismic apparatus.

It may be said that the summit of Etna is an astronomical and meteorological station, placed under exceptionally favorable conditions. At intervals of a few years, this peace is interrupted by terrible paroxysms in which the mountain and its surroundings are violently shaken. The volcano usually opens at the sides, vomits up its contents, throws out blocks that are sometimes 30 cubic feet in volume, and ejects torrents of incandescent lava that enters, burns and buries the for-



FIG. 3.—CENTRAL CRATER OF ETNA AND VULCAROLO SEEN FROM THE OBSERVATORY (SOUTH).

Casa del Bosco (4,700 ft.), and to the Alpine meteorological station (6,140 ft.), and then by more or less visible and practicable footpaths.

In summer persons come by mule up to the very door of the observatory. In winter the mules very rarely go beyond Casa del Bosco, and the rest of the journey is performed upon the snow, which is usually soft and fatiguing to walk over. The observatory is then buried under 6 to 15 ft. of snow, so that it has to be entered through a window in the first story. It may be said that the enemy is not the volcano, but the snow. Moreover, there is no mountain sickness from which one cannot rid himself by habituation.

The position of the observatory is as follows:

Altitude 9,650 feet.
Latitude 37° 44' 3"
Longitude, east..... 2° 33' 8" (Rome).



FIG. 4.—THE ASTRONOMICAL OBSERVATORY ON THE SUMMIT OF ETNA (9,652 FEET).

It is situated at about half a mile from the southern edge of the central crater, which is 10,860 ft. in height, and, consequently, overlooks the observatory 1,216 ft. to the north-northwest.

From the meteorological observations made since 1892, the following data have been obtained:

	Mean temperature.
Winter.....	6°6'
Spring.....	1°5'
Summer.....	7°3'
Autumn.....	2°7'
Year.....	0°4'

Annual means of other meteorological data:

Pressure.....	533.9 mm.
Tension of vapor.....	3.2 "
Relative humidity.....	65
Prevailing wind.....	N.E.
Precipitation.....	37 days.

The calculated temperature of the summit should

Dr. Peters was the natural leader of this expedition. He was not only active in proposing the preliminary Wolfe expedition to Babylonia, in the years 1884-85, led by Dr. Ward, but by interesting Bishop Potter, and through him Miss Catherine Wolfe, in the subject, he secured the \$5,000 which made that expedition possible. It was Dr. Peters' energy which secured the funds for a more ambitious expedition, through liberal friends of the University of Pennsylvania, with which Dr. Peters was then connected as professor of Hebrew, as well as with the Episcopal Seminary in Philadelphia. To these public-spirited gentlemen, among whom we may mention the brothers E. W. and C. H. Clarke, he dedicates this volume.

Dr. Ward had rapidly visited all the important sites in Babylonia, with the exception of Sifr, Larsa and Abu Sharein, and had specially recommended Niffer or Nuffar (the ancient Nippur) as a site for exploration by an American expedition. After full study Dr. Peters selected this site for excavation, and its name is given to this volume. Work has been carried on

facial neuralgia and consequent sleeplessness. In fact, I was on the verge of collapse, and the world had never seemed quite so black before."

Indeed, things were black. An Arab thief had been shot by their Turkish soldier. Dr. Peters had mistakenly refused to pay blood money. The Arabs had burned their camp and robbed them of twelve hundred dollars in gold; they were escaping in danger of their lives, some of their horses having been burned. Turks as well as Arabs were hostile. All the American members had sent in their resignations. Dr. Peters was recalled to Philadelphia, and the whole expedition was likely to be given up and to end in failure. It is to the great credit of the gentlemen connected with the university that they decided to continue another year with a smaller force, consisting only of Dr. Peters, Mr. Haynes and Mr. Noorian. The result of that decision was a success which has received the warmest recognition of the best European scholars. It is useless to deny that the disaster of the first year—apart from the failure to reach the valuable antiquities—was due in part to inexperience, and in part to what is included under the general term of incompatibilities. Success in dealing with Arabs requires knowledge of their character, and an avoidance of any apparent suspicion of them. The lack of these conditions has wrecked not a few expeditions in which young, eager and positive men have been thrown into relations intimate enough to produce other than friendly feelings. This volume suggests and sometimes exposes the personal infelicities of the first year. Some words about Dr. Peters' companions might quite as well have been omitted. We shall be surprised if they do not provoke unpleasant rejoinders.

Of the difficulties experienced in securing a firmman we need not speak. Most of the volume is taken up with the story of the delay in Constantinople and the journey down the Euphrates, along routes traversed by many travelers. The one important discovery recorded is the identification of Kalat Dibse with the biblical Tiphshah and the classical Thapsacus. This, we believe, is new, and needs, as Dr. Peters suggests, further investigation, especially as of the four consonants in Tiphshah only one appears in Dibse, which has precisely the consonants of the Hebrew and Arabic word for honey or sirup, so that one would naturally suppose Kalat Dibse to mean the Village of Date Sirup, Dibse being for dibs. Yet that the corruption might come by volkymologie from Tiphshah we would not deny, if the locality fits as well as is said.

It is not an eventful story which Dr. Peters tells of his trip down the Euphrates. It is a region traveled over by many armies and many voyageurs, but no one yet has explored it, as Edward Robinson did Palestine, with a previous knowledge of the entire history and literature of the region, Greek and Arabic, so as to be able on the spot to know what old sites are to be located. The most careful subsequent study in libraries will not compensate for the cursory traveler's necessary ignorance at the time. Doubtless Dr. Peters would be glad to visit the country again with better educated eyes. As it is he has supplemented his necessarily hasty notes of daily movement with historical and geographical information derived chiefly from Ainsworth, Chesney, Procopius, etc. Strangely, he does not find Cernik of any value, and does not mention him except briefly in an appendix. We should have supposed his "Studien-Expedition" to be of the highest value topographically, as its map is certainly the best we have of this part of the valley. There were no adventures more exciting than one of the company falling into the Euphrates, nothing certainly so serious as Ainsworth's being left behind by his steamer and having to walk fifty miles under the guidance of Arab robbers before he overtook his party.

The real interest of the volume begins, of course, near its end, when the party reached Niffer and began their excavations. Sixty pages are given to the two and a half months which constituted the first campaign that ended so disastrously, the camp burned, the money stolen, the Arabs furious, almost nothing discovered, the expedition broken up by the resignation of its members, and its director recalled to Philadelphia. Perhaps a fuller account of these dozen weeks would have been interesting, even at the expense of reducing the observations about Constantinople and the journey; but the scientific results, which were secured the next year, will come in the second volume. The failure of the first year, which Dr. Peters can afford

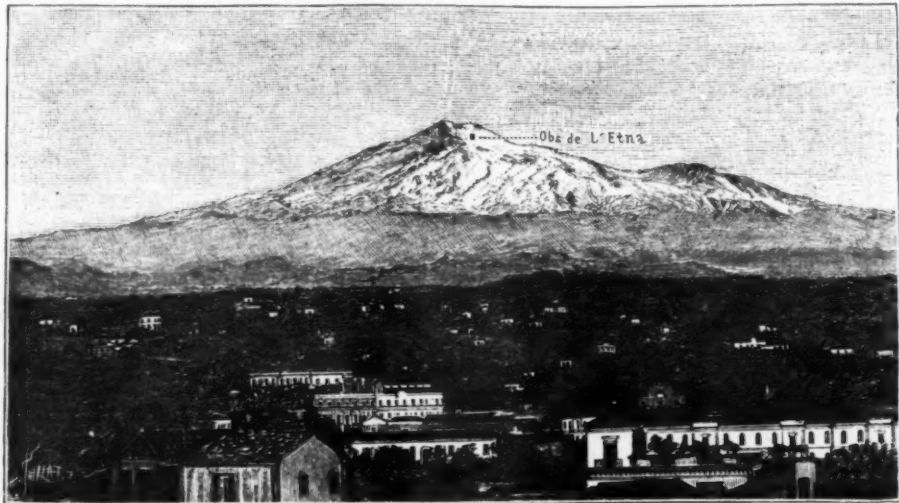


FIG. 5.—ETNA AND THE OBSERVATORY AS SEEN FROM THE CATANIA OBSERVATORY.

be 2°2' lower than that noted at the observatory. The direct measurement of such temperature gives 0°6' more. This is the effect of reheating due to the crater.

The spectroscopic observations have given the following averages, reduced to the normal mass of the atmosphere traversed:

	Observatories.	
	Etna.	Catania.
Thickness of the atmospheric band, α	1.7	1.4
Intensity of the zone, δ	0.5	0.4
Intensity of the rain band.....	0.5	1.2

Electric manifestations upon Etna are rare and occur mainly in autumn. It is not certain that lightning has struck the Casa Inglese once since 1810.

The Etna observatory, which is built over that old hut, has never been struck, although there is no lightning rod, and the great metallic mass of the cupola and roof are deprived of all communication with the ground. This rareness does not seem to depend upon that of the aqueous vapor, since upon the Alps, where such vapor is still rarer, there are often imposing electric manifestations. With Etna, we certainly have to take into account the protective action of the central crater, the great plume of smoke and hot steam of which acts silently like a gigantic lightning protector. —La Nature.

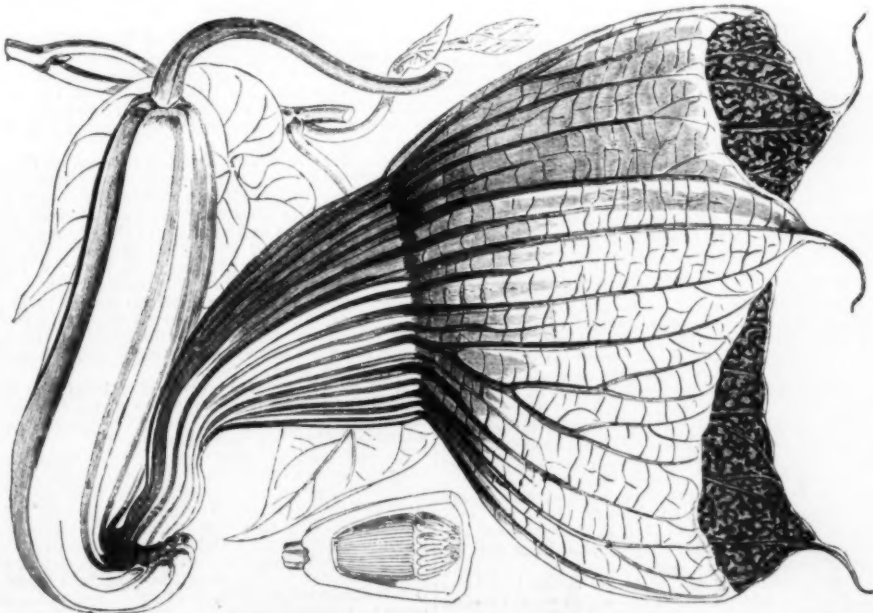
ARISTOLOCHIA GOLDIEANA.

ONE of the most extraordinary flowers in bloom in the Victoria house, Kew, is this West African species. The flower is naturally pendulous, or nearly so, the lower part of the tube is irregularly cylindrical, cream-colored, smooth, and bent upward nearly at a right angle into a funnel-shaped upper half. This part of the tube is marked with prominent purple ribs, and expands into a bowl-shaped three-lobed limb, strongly marked with purplish ribs, the three lobes prolonged into acuminate points; the interior of the bowl is yellowish, thickly marbled with velvety purplish brown spots. The entire flower is as large as one's hat, and very striking in appearance, just one of those interesting plants which the floral committee would pass over as of no commercial value. Although in point of size, form and color it is very attractive, we cannot say so much for its odor.—Gardeners' Chronicle.

EXPLORATIONS OF THE UNIVERSITY OF PENNSYLVANIA IN BABYLONIA.*

THIS fine volume, to be followed by its mate, telling the story of the first great expedition for excavation in old Babylonia, sent from the United States by the University of Pennsylvania, is not published by the university, as might have been expected, but by a New York firm. With a good deal of confidence we assume that the reason is that Dr. Peters, as director of that expedition, having left his position as a teacher in the university to become the rector of a large New York church, in lineal succession to his father and grandfather, does not care to have his work supervised by the scholar, no matter how able, who edits for the university its publications on the expedition, and who was, during the years here described, his subordinate. Dr. Peters can thus speak with a certain freedom which has its advantages and disadvantages.

* "Nippur; or, Explorations and Adventures on the Euphrates." The Narrative of the University of Pennsylvania Expedition to Babylonia in the years 1888-1890. By John Punnett Peters, Ph.D., Sc.D., D.D., Director of the Expedition. With illustrations and maps. Volume I, First Campaign. 8vo, pp. xv, 375. G. P. Putnam's Sons, New York.



ARISTOLOCHIA GOLDIEANA—FLOWER CREAM-COLORED, WITH PURPLE RIBS AND SPOTS ON A YELLOW GROUND.

distinctly to acknowledge, had its causes, which he has partly intimated, and, we judge, partly withheld. Each member of the expedition would tell his own story. Dr. Peters, on whom the chief responsibility rested, deserves the credit of great determination and of the final victory over difficulties. He was able to go back the second year, conquering all adverse circumstances, and with fewer companions achieved at last a great success. The story he tells is of much interest, and the volume a valuable addition to the history of Oriental exploration.

We are not quite satisfied with the illustrations; but it is not Dr. Peters' fault that so many of the photographs taken in his expedition failed to develop. Most of the valuable pictures are from the photographs of the previous Wolfe expedition, for which general credit is given in the introduction. Of the other pictures we note as specially interesting the framework of an Affech hut of reeds and mats and one of the two pictures of the excavations.

In an appendix, following the Turkish irade authorizing the expedition, and other documents, are sixty pages of extracts from Dr. Ward's diary, taken on the Wolfe expedition. It was his intention to prepare a volume on that expedition, which was solely one of rapid survey, to learn whether such an expedition as that led later by Dr. Peters would be feasible, and to recommend sites for exploration. Other duties prevented him from carrying out his literary purpose, and he put his diary at the service of Dr. Peters, who was compelled to abridge it, omitting diagrams and what seemed to him less important, but retaining the numerous records of angular bearings taken from the various mounds, which ought to be of great value in constructing a map, inasmuch as no map exists of value for the region south of that so carefully plotted by Collingwood and Bewsher.—The Independent.

[Continued from SUPPLEMENT, No. 1131, page 18082.]

ADDRESS BY SIR JOHN EVANS,

K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A., For. Sec. G. S.; Correspondant de l'Institut de France, etc.; President of the British Association for the Advancement of Science.*

IN his address to this association at the Bath meeting of 1864, Sir Charles Lyell struck so true a note that I am tempted to reproduce the paragraph to which I refer:

"When speculations on the long series of events which occurred in the glacial and post-glacial periods are indulged in, the imagination is apt to take alarm at the immensity of the time required to interpret the monuments of these ages, all referable to the era of existing species. In order to abridge the number of centuries which would otherwise be indispensable, a disposition is shown by many to magnify the rate of change in prehistoric times by investing the causes which have modified the animate and inanimate world with extraordinary and excessive energy. It is related of a great Irish orator of our day that when he was about to contribute somewhat parsimoniously toward a public charity, he was persuaded by a friend to make a more liberal donation. In doing so he apologized for his first apparent want of generosity by saying that his early life had been a constant struggle with scanty means, and that 'they who are born to affluence cannot easily imagine how long a time it takes to get the chill of poverty out of one's bones.' In like manner we of the living generation, when called upon to make grants of thousands of centuries in order to explain the events of what is called the modern period, shrink naturally at first from making what seems so lavish an expenditure of past time. Throughout our early education we have been accustomed to such strict economy in all that relates to the chronology of the earth and its inhabitants in remote ages, so fettered have we been by old traditional beliefs, that even when our reason is convinced, and we are persuaded that we ought to make more liberal grants of time to the geologist, we feel how hard it is to get the chill of poverty out of our bones."

Many, however, have at the present day got over this feeling, and of late years the general tendency of those engaged upon the question of the antiquity of the human race has been in the direction of seeking for evidence by which the existence of man upon the earth could be carried back to a date earlier than that of the quaternary gravels.

There is little doubt that such evidence will eventually be forthcoming, but, judging from all probability, it is not in northern Europe that the cradle of the human race will eventually be discovered, but in some part of the world more favored by a tropical climate, where abundant means of subsistence could be procured and where the necessity for warm clothing did not exist.

Before entering into speculations on this subject or attempting to lay down the limits within which we may safely accept recent discoveries as firmly established, it will be well to glance at some of the cases in which implements are stated to have been found under circumstances which raise a presumption of the existence of man in pre-glacial, Pliocene or even Miocene times.

Flint implements of ordinary paleolithic type have, for instance, been recorded as found in the eastern counties of England, in beds beneath the chalky boulder clay; but on careful examination the geological evidence has not to my mind proved satisfactory, nor has it, I believe, been generally accepted. Moreover, the archaeological difficulty that man, at two such remote epochs as the preglacial and the postglacial, even if the term glacial be limited to the chalky boulder clay, should have manufactured implements so identical in character that they cannot be distinguished apart, seems to have been entirely ignored.

Within the last few months we have had the report of worked flints having been discovered in the late Pliocene forest bed of Norfolk, but in that instance the signs of human workmanship upon the flints are by no means apparent to all observers.

But such an antiquity as that of the forest bed is as nothing when compared with that which would be implied by the discoveries of the work of men's hands in the Pliocene and Miocene beds of England, France,

Italy, and Portugal, which have been accepted by some geologists. There is one feature in these cases which has hardly received due attention, and that is the isolated character of the reputed discoveries. Had man, for instance, been present in Britain during the Crag period, it would be strange indeed if the sole traces of his existence that he left were a perforated tooth of a large shark, the sawn rib of a manatee, and a beaming full face carved on the shell of a pectenulus!

In an address to the Anthropological Section at the Leeds meeting of this association in 1890 I dealt somewhat fully with these supposed discoveries of the remains of human art in beds of tertiary date; and I need not here go further into the question. Suffice it to say that I see no reason why the verdict of "not proven" at which I then arrived should be reversed.

In the case of a more recent discovery in Upper Burma in beds at first pronounced to be upper Miocene, but subsequently "definitely ascertained to be Pliocene," some of the flints are of purely natural and not artificial origin, so that two questions arise: first, Were the fossil remains associated with the worked flints or with those of natural forms? And second, Were they actually found in the bed to which they have been assigned or did they merely lie together on the surface?

Even the Pithecanthropus erectus of Dr. Eugene Dubois from Java meets with some incredulous objectors from both the physiological and the geological sides. From the point of view of the latter the difficulty lies in determining the exact age of what are apparently alluvial beds in the bottom of a river valley.

When we return to paleolithic man, it is satisfactory to feel that we are treading on comparatively secure ground, and that the discoveries of the last forty years in Britain alone enable us to a great extent to reconstitute his history. We may not know the exact geological period when first he settled in the British area, but we have good evidence that he occupied it at a time when the configuration of the surface was entirely different from what it is at present; when the river valleys had not been cut down to anything like their existing depth, when the fauna of the country was of a totally different character from that of the present day, when the extension of the southern part of the island seaward was in places such that the land was continuous with that of the continent, and when in all probability a far more rainy climate prevailed. We have proofs of the occupation of the country by man during the long lapse of time that was necessary for the excavation of the river valleys. We have found the old floors on which his habitations were fixed, we have been able to trace him at work on the manufacture of flint instruments, and by building up the one upon the other the flakes struck off by the primeval workman in those remote times we have been able to reconstruct the blocks of flint which served as his material.

That the duration of the paleolithic period must have extended over an almost incredible length of time is sufficiently proved by the fact that valleys some miles in width and of a depth of from 100 to 150 feet have been eroded since the deposit of the earliest implement-bearing beds. Nor is the apparent duration of this period diminished by the consideration that the floods which hollowed out the valleys were not in all probability of such frequent occurrence as to teach paleolithic man by experience the danger of settling too near to the streams, for had he kept to the higher slopes of the valley there would have been but little chance of his implements having so constantly formed constituent parts of the gravels deposited by the floods.

The examination of British cave deposits affords corroborative evidence of this extended duration of the paleolithic period. In Kent's cavern at Torquay, for instance, we find in the lowest deposit, the breccia below the red cave earth, implements of flint and chert corresponding in all respects with those of the high level and most ancient river gravels. In the cave earth these are scarce, though implements occur which also have their analogues in the river deposits; but, what is more remarkable, harpoons of reindeer's horn and needles of bone are present, identical in form and character with those of the caverns of the reindeer period in the south of France, and suggestive of some bond of union or identity of descent between the early troglodytes, whose habitations were geographically so widely separated the one from the other.

In a cavern at Creswell Crags, on the confines of Derbyshire and Nottinghamshire, a bone has, moreover, been found engraved with a representation of parts of a horse in precisely the same style as the engraved bones of the French caves.

It is uncertain whether any of the river drift specimens belong to so late a date as these artistic cavern remains; but the greatly superior antiquity of even these to any neolithic relics is testified by the thick layer of stalagmite, which had been deposited in Kent's Cavern before its occupation by men of the neolithic and bronze periods.

Toward the close of the period covered by the human occupation of the French caves there seems to have been a dwindling in the number of the larger animals constituting the quaternary fauna, whereas their remains are present in abundance in the lower and therefore more recent of the valley gravels. This circumstance may afford an argument in favor of regarding the period represented by the later French caves as a continuation of that during which the old river gravels were deposited, and yet the great change in the fauna that has taken place since the latest of the cave deposits included in the paleolithic period is indicative of an immense lapse of time.

How much greater must have been the time required for the more conspicuous change between the old quaternary fauna of the river gravels and that characteristic of the neolithic period!

As has been pointed out by Prof. Boyd Dawkins, only thirty-one out of the forty-eight well ascertained species living in the postglacial or river drift period survived into prehistoric or neolithic times. We have not, indeed, any means at command for estimating the number of centuries which such an important change indicates; but when we remember that the date of the commencement of the neolithic or surface stone period is still shrouded in the mist of a dim antiquity, and that prior to that commencement the river drift period had long come to an end; and when we further take into account the almost inconceivable ages that even under the most favorable conditions the excavation of wide

and deep valleys by river action implies, the remoteness of the date at which the paleolithic period had its beginning almost transcends our powers of imagination.

We find distinct traces of river action from 100 to 200 feet above the level of existing streams and rivers, and sometimes at a great distance from them; we observe old fresh water deposits on the slopes of valleys several miles in width; we find that long and lofty escarpments of rock have receded unknown distances since their summits were first occupied by paleolithic man; we see that the whole side of a wide river valley has been carried away by an invasion of the sea, which attacked and removed a barrier of chalk cliffs from 400 to 600 feet in height; we find that what was formerly an inland river has been widened out into an arm of the sea, now the highway of our fleets, and that gravels which were originally deposited in the bed of some ancient river now cap isolated and lofty hills.

And yet, remote as the date of the first known occupation of Britain by man may be, it belongs to what, geologically speaking, must be regarded as a quite recent period, for we are now in a position to fix with some degree of accuracy its place on the geological scale. Thanks to investigations ably carried out at Hoxne, in Suffolk, and at Hitchin, in Hertfordshire, by Mr. Clement Reid, under the auspices of this association and of the Royal Society, we know that the implement-bearing beds at those places undoubtedly belong to a time subsequent to the deposit of the great chalky boulder clay of the eastern counties of England. It is, of course, self-evident that this vast deposit, in whatever manner it may have been formed, could not, for centuries after its deposition was complete, have presented a surface inhabitable by man. Moreover, at a distance but little farther north, beds exist which also, though at a somewhat later date, were apparently formed under glacial conditions. At Hoxne the interval between the deposit of the boulder clay and of the implement-bearing beds is distinctly proved to have witnessed at least two noteworthy changes in climate. The beds immediately reposing on the clay are characterized by the presence of alder in abundance, of hazel, and yew, as well as by that of numerous flowering plants indicative of a temperate climate very different from that under which the boulder clay itself was formed. Above these beds characterized by temperate plants, comes a thick and more recent series of strata, in which leaves of the dwarf Arctic willow and birch abound, and which were in all probability deposited under conditions like those of the cold regions of Siberia and North America.

At a higher level and of more recent date than these—from which they are entirely distinct—are the beds containing paleolithic implements, formed in all probability under conditions not essentially different from those of the present day. However this may be, we have now conclusive evidence that the paleolithic implements are, in the eastern counties of England, of a date long posterior to that of the great chalky boulder clay.

It may be said, and said truly, that the implements at Hoxne cannot be shown to belong to the beginning rather than to some later stage of the paleolithic period. The changes, however, that have taken place at Hoxne in the surface configuration of the country prove that the beds containing the implements cannot belong to the close of that period.

(To be continued.)

[Continued from SUPPLEMENT, No. 1131, page 18081.]

EDWARD DRINKER COPE, NATURALIST.*

VII.

COPE was not satisfied with the study of morphological details or simple taxonomy. He aspired to know how animals came into existence; why they varied as they did, and what laws determined their being. His was an eminently philosophical mind, but at the same time with a decided tendency to metaphysical speculation. In one of his earliest papers he manifested this tendency and it persisted through life. It is with much hesitation that I venture to give an exposition of his most salient views, for I must confess I do not altogether like his philosophy and am able to subscribe to it only in part. I cannot but wish that one of his numerous disciples could have been chosen for this task. But I must not pass it by, for it is the most characteristic feature of Cope's work and the one he most esteemed.

Cope began his public scientific career, it will be remembered, in the same year in which Darwin's long studies had fructified into his "Origin of Species."

As was quite natural with his keen instincts, Cope early adopted the doctrine of transmutation of species and recognized the truth that all the animals of the present epoch are descendants from those of past times with modifications which separate them as species, and eventually as representatives of genera, of families and orders differing from the earlier ones as we retrace the steps of Time farther and farther back. He was not, however, satisfied with Darwin's theory, and denied that natural selection was a sufficient factor for differentiation. He would not admit that animals were passive subjects and that the slight variations which were manifest in the progeny of species were sufficient to enable Nature to select from and to fit for future conditions. He contended that the volition and endeavors of an animal had much to do with future progeny as well as its own brief life. In short, he claimed that characters acquired by animals through their own efforts or forced on them by various external agencies or accidents might be transmitted to their offspring. He further, first in a chapter in his "Synopsis of the Cyprinidæ of Pennsylvania" outlined, and later, in "The Origin of Genera," he elaborated a peculiar theory characterized mainly by what he called (with Prof. Hyatt) "the law of acceleration and retardation" in development. Darwin complained that he could never understand this law, and Cope complained that Darwin had not stated his views correctly in an attempted abstract. I therefore give Cope's views, restated in his own language, summarizing them years afterward. "The following doctrines," he says, "were taught:"

"First, that the development of new characters has

* Presidential address by Prof. Theodore Gill before the annual meeting of the American Association for the Advancement of Science, August 9, 1897.

been accomplished by an acceleration or retardation in the growth of the parts changed. This was demonstrated by reference to a class of facts, some of which were new, which gave ground for the establishment of the new doctrine.

"Second, that of exact parallelism between the adult of one individual or set of individuals and a transitional stage of one or more other individuals. This doctrine is distinct from that of inexact parallelism, which had already been stated by Von Baer. And that this law expresses the origin of genera and higher groups, because,

"Third, they can only be distinguished by single characters when all their representatives come to be known.

"Fourth, that genera and various other groups have descended, not from a single generalized genus, etc., of the same group, but from corresponding genera of one or more other groups. This was called the doctrine of homologous groups.

"Fifth, the doctrine that these homologous groups belong to different geological periods, and,

"Sixth, to different geographical areas, which, therefore, in some instances, are,

"Seventh, related to each other in a successional way like the epochs of geological time.

"Of these doctrines it may be observed that the first and second are now the common property of evolutionists, and are recognized everywhere as matter of fact. The names which I selected to express them have, however, only come into partial use. The author believes that, although the doctrine was vaguely shadowed out in the minds of students prior to the publication of this essay, it had not previously been clearly expressed nor been reduced to a demonstration. Of the truth of the doctrine the author is more than ever convinced, and he believes that paleontological discovery has demonstrated it in many instances, and that other demonstrations will follow. The fourth proposition (that of homologous groups) is now held as a hypothesis explaining the phylogeny of various groups of animals. For the descent of one homologous group from another, the term polyphyletic has been coined. It remains to be seen whether the doctrine is of universal application or not. That homologous groups belong to different geological horizons, as stated under the fifth head, has been frequently demonstrated since the publication of the essay. That the sixth proposition is true in a certain number of cases is well known, and it follows that the seventh proposition is also true in those cases. The latter hypothesis, which was originally advanced by Prof. Agassiz, is, however, only partially true, and the advance of paleontological study has not demonstrated that it has had a very wide application in geological time.

"A proposition which was made prominent in this essay was that the prevalence of non-adaptive characters in animals proves the inadequacy of hypotheses which ascribe the survival of types to their superior adaptation to their environment. Numerous facts of this kind undoubtedly indicate little or no activity of a selective agency in nature, and do point to the existence of an especial developmental force acting by a direct influence on growth. The action of this force is the acceleration and retardation appealed to in this paper. The force itself was not distinguished until the publication of the essay entitled 'The Method of Creation' [1871], where it was named growth force, or bathmism. The energetic action of this force accounts for the origin of characters, whether adaptive or non-adaptive, the former differing from the latter in an intelligent direction, which adapts them to the environment. The numerous adaptive characters of animals had by that time engaged the attention of the author, and he found that they are even more numerous than the non-adaptive. Some of the latter were accounted for on the theory of the 'complementary location of growth force.'

We can only consider the "law of acceleration and retardation." Again it behooves us to seek his own definition:

"a. The succession of construction of parts of a complex was originally a succession of identical repetitions; and grade influence merely determined the number and location of such repetitions.

"b. Acceleration signifies addition to the number and location of such repetitions during the period preceding maturity, as compared with the preceding generation, and retardation signifies a reduction of the number of such repetitions during the same time."

His meaning may best be inferred from his application to mankind. This was done in the following terms in 1872:†

"Let an application be made to the origin of the human species. It is scarcely necessary to point out at the start the fact, universally admitted by anatomists, that man and monkeys belong to the same order of mammalia, and differ in those minor characters generally used to define a 'family' in zoology.

"Now, these differences are as follows: In man we have the large head with prominent forehead and short jaws; short canine teeth without interruption behind (above); short arms, and thumb of hand not opposable. In monkeys we have the reverse of all these characters. But what do we see in young monkeys? A head and brain as large relatively as in many men, with jaws not more prominent than in some races; the arms not longer than in the long-armed races of men, that is, a little beyond half way along the femur. . . . At this age of the individual the distinctive characters are therefore those of homo, with the exception of the opposable thumb of the hind foot and the longer canine tooth.

"Now in the light of various cases observed, where members of the same species or brood are found at adult age to differ in the number of immature characters they possess, we may conclude that man originated in the following way; that is, by a delay or retardation of growth of the body and fore limbs as compared with the head; retardation of the jaws as compared with the brain case, and retardation in the protrusion of the canine teeth."

There is good reason for thinking that fallacy is involved in this argument and that quite a different interpretation should be put on the evolution of the

characters in question. It is not the fore limbs that are retarded in man, but the hind limbs have become enlarged (compare the adult and the infant). There is not retardation of the jaws, but a special teleological adaptation. Man has for the most part at least discontinued the use of his teeth for warfare, and as a result of diminished use the canines have become reduced and the diastemata of the dental series been obliterated. The brain has grown after birth and become enlarged, and as a consequence the brain case has extended forward—the reverse of what occurs in the apes. Concomitantly with the diminished use of the teeth and jaws, the masseter and temporal muscles have become reduced and the sagittal and lambdoidal ridges have consequently become atrophied. The earriate rounded voluminous calvarium is the result.

It has been claimed that the young of higher species "are constantly accelerating their development." In man, however, development is retarded, inasmuch as infancy and juvenility are prolonged far beyond the periods observed in our simian relatives.

Such examples as this give cause to believe that the "law of acceleration and retardation" has been at least unduly extended. Acceleration and retardation are, however, to a large extent, terms which express facts of evolution; whether the word law is applicable may depend on the meaning one gives the word.

The transmission of acquired characters was one of the accepted and most cherished dogmas of Cope, and the belief in transmissibility of such characters is an essential of the creed of so many who have become his followers in America that a special school came into existence known as the Neo-Lamarckian and also as the American school. My own prejudices have inclined me to that school. Nevertheless, when I have divested myself of such prejudices as well as I could, I have been compelled to admit that the evidence of the heredity of acquired characters was rather weak. There was, indeed, evidence for, as well as against, but that against the doctrine of the transmissibility of acquired characters seems to be the most weighty.

It is to be understood that the acquired characters considered in this connection are such as have been developed during postnatal life as a result of endeavors of the animal or of the influence of external agencies. The evidence presented has been mostly in support of the contention that the characters acquired have been directly inherited by offspring, and consequently the transition from the form not possessing the character to one having it is rapid. The evidence adduced has not been conclusive, to say the least. There is, apparently, a germ of truth in the proposition that acquired characters are transmitted, but in a modified sense, and the case has been weakened rather than strengthened by the evidence offered.

The evidence for inheritance of acquired characters was frequently given by Cope, and in his last published work, "The Primary Factors of Organic Evolution," he marshaled the testimonies of many witnesses with his accustomed skill. He evoked "evidence from embryology," "evidence from paleontology," "evidence from breeding"; he considered the "characters due to nutrition," "characters due to exercise of function," "characters due to disease," "characters due to mutilation and injuries," and "characters due to regional influence"; he inquired into "the conditions of inheritance," and he fought against the "objections to the doctrine of inheritance of acquired characters." I have gone over all this evidence and yet I have not been convinced that the contention has been sustained that characters acquired during the external life of an animal are transmitted. Many cases are alleged to sustain the "inheritance of characters due to mutilation and injuries." Some of these may be considered as mere coincidences; others provoke skepticism for one reason or other. To discuss them would be out of place here. But at least we may meet evidence with counter evidence.

On the one hand, all the data and experiments recapitulated in the cases enumerated concern only two, or at most very few, generations of the animals in question, and were within the compass of a single man's lifetime.

On the other hand, we have data and observations of the most reliable nature, and of an extraordinary compass. These have resulted not from experiments for the determination of a specific question, but from observances of a religious character. They were really in the nature of surgical operations, but for our purpose may be looked upon as experiments and have the value of contrived experiments. In no other field has such a series of disinterested experiments been available. They were conducted on countless millions of mankind and for thousands of years. The subjects experimented upon were kept isolated from others alike by their own prejudices and the prejudices of their neighbors. Circumcision is the term applied to the experiments in question.

For about 4,000 years circumcision has been practiced on a gigantic scale. Every male child among the Jews was operated upon, not only in Palestine, but wherever representatives of the race had wandered and adhered to their religion; religion itself was involved in the operation and it was regarded as a holy rite; the most scrupulous attention was paid to details. The operation was performed eight days after birth, and consequently there could be no functional activity of the tissues concerned. But after 4,000 years the new-born boys of the race come into the world with the special integument developed as much as in those of other races. Even the principle of atrophy through disuse has not become manifest in the case.

Other evidence, it seems to me, is the result of confounding the potentiality of a function with its manifestation. I allude to one set of examples on account of the interest of the cases, and I do so with the deference due to the eminence and ability of the gentleman who has furnished the evidence. That evidence has been collected under the head of "inheritance of characters due to the exercise of function." The evolution of the American trotting horse was considered. It was recorded that "by 1810 the taste for trotting as a sport had . . . increased here, and in 1818 it became a recognized sport under specific rules. . . . At the end of 1824, six years after the first accepted three-minute record, the record had fallen to 2:24. . . . By 1848 the record was lowered to 2:20 1/4; the next decade lowered the record five seconds. . . . Finally, at the close of 1896, the record had been further lowered

to 2:03 1/4." It is deduced from these premises that "there is nothing whatever in the actual phenomena observed anywhere along the line of this development of speed that would lead us to even suspect that the changes due to exercise of function had not been a factor in the evolution." But to me it seems that there is no evidence to show that the speed attained was other than would have resulted from taking the same animals untrained and then speeding the last. The speed is, of course, simply the expression of functional adaptation, and the horses were selected merely because, by their manifestation, they showed that they had the co-ordination of structural and psychological characters needed for the manifestation of the function. The manifestation guided the breeder to the selection of the animals. The successful animals were the pick of thousands unknown to fame.

But there is much in the history of the development of animals that seems to lead to the belief that eventually modifications may be due in part to acts of representatives of the phylum to which they belong. It is difficult to believe that some structural features are simply the result of natural selection operating on chance variations. An application of the doctrine of chances to some such cases appears to be adverse to the conception that they represent the influence of natural selection unaided.

A feature characteristic of most cave animals of widely diverse groups and classes is the atrophy of the eyes, and it seems to be most logical to attribute this to disuse of those organs in remote progenitors, and to assume that the atrophy may have resulted from a failure of nourishment by the nutrient fluid of the organs on account of the loss of functional activity rather than to selection by nature of forms with successively diminishing eyes. The presence of eyes in most cases certainly would scarcely be an element of disadvantage to animals, and it may be allowable to invoke some other agency than chance selection. We may be justified in postulating that the continuous disuse of the organs would in time react on the nutrition of the parts affected, and finally atrophy or disappearance would result. Like explanation would be applicable to the innumerable cases of atrophy of parts known to the naturalist.

But if cessation of nutrition culminates in final atrophy, increased nutrition of parts may result in hypertrophy and increased nutrition may be the concomitant of increased activity of parts. The exercise of such parts continued for many generations may react on the organization and the progeny at length be affected thereby. Of such cases Cope adduced many examples. The feet of the horse line furnish illustrations. The existing horse has the median toes and hoofs greatly hypertrophied and the lateral ones atrophied, but the remote ancestors had feet of nearly the same general pattern as the rhinoceroses and tapirs. Atrophy of the lateral digits has progressed inversely to hypertrophy of the middle ones. An analogous line of development culminating in feet superficially much like those of the horse was followed by another quite remote family of hoofed mammals, the Prototheriids of South America.

The idea of acceleration and retardation was associated by Cope with the idea that the course of evolution was determined from the beginning of things, and that life, to use his own words, is "energy directed by sensibility or by a mechanism which has originated under the direction of sensibility." He maintained that "consciousness as well as life preceded organism," and he called this conception "the hypothesis of archæstheticism." This idea I refer to especially because it was broached in his vice-presidential address, delivered at the meeting of the American Association for the Advancement of Science, in Philadelphia, in 1884.*

I am myself unable to comprehend consciousness except as a product or result of organization, and those who wish to learn more about Cope's views respecting the question must refer to one of his many papers.

Whatever may be thought of Cope's philosophical views, his presentation of them is always interesting and some of them are illustrated with a wealth of facts that renders his communications valuable as repositories of well digested information. His first special paper, on "The Origin of Genera," published as early as 1868, is especially noteworthy for the mass of morphological data contained in it and for the apt manner in which they are tabulated.

VIII.

I venture to conclude with some reflections on the rank that may be assigned to Cope in the world of Science.

Among those that have cultivated the same branches of science that he did—the study of the recent as well as the extinct vertebrates—three naturalists have acquired unusual celebrity. Those are Cuvier, Owen and Huxley.

Cuvier excelled all of his time in the extent of his knowledge of the anatomical structure of animals and appreciation of morphological details, and first systematically applied them to and combined them with the remains of extinct vertebrates, especially the mammals and reptiles. He was the real founder of vertebrate paleontology.

Owen, a disciple of Cuvier, followed in his footsteps, and, with not unequal skill in reconstruction and with command of ampler materials, built largely on the structure that Cuvier had begun.

Huxley covered as wide a field as Cuvier and Owen, and likewise combined knowledge of the details of structure of the recent forms with acquaintance with the ancient ones. His actual investigations were, however, less in amount than those of either of his predecessors. He excelled in logical and forcible presentation of facts.

Cope covered a field as extensive as any of the three. His knowledge of structural details of all the classes of vertebrates was probably more symmetrical than that of any of those with whom he is compared; his command of material was greater than that of any of the others; his industry was equal to Owen's; in the clearness of his conceptions he was equaled by Huxley alone; in the skill with which he weighed discovered facts, in the aptness of

* Origin of Fittest, p. 425.

* Proc. Am. Phil. Soc., 1871; Origin of Fittest, p. 182.

† Penn. Monthly Mag., 1872; Origin of the Fittest, p. 11, 1887.

that it is a question in Paris of an interesting experiment that will give an idea of the practical value of propulsion by means of Tudor accumulators. Some interesting results have already been obtained at Hanover. —La Nature.

LIGHTHOUSE PROGRESS, 1887-1897.

IN 1887 some account was given in Nature of lighthouse work and progress in the United Kingdom during the preceding fifty years. I propose in this article to consider briefly the same subject in connection with the past ten years, so that the whole may form a summary record of what has been attained during the Victorian era in this important branch of optical and mechanical science.

And, first, it may be asserted that the period of the Queen's reign, distinguished as it is for so many developments of new industries, can boast of none more valuable or more interesting than this now in question. Fresnel's monumental invention in 1819 of the dioptric system of lights was at once welcomed and realized by the French government, who have since always encouraged and supported the native constructors of lenticular apparatus. But it was only after thirty years from this date that the lighthouse industry was planted in England, if we except the experimental attempts of Messrs. Cookson, of Newcastle. The systematic and permanent establishment is due to the public spirit and the enterprise of Messrs. Chance Brothers, subsequently aided by the mathematical talents and personal direction of Mr. James T. Chance, whose services to the Royal Commission on Lights of 1860, as well as to the Trinity House, and whose writings on lighthouse optics, are widely known. It is said that great pecuniary loss re-

and best arrangements for the production and transmission of its weird and inimitable notes.

Many of our land lights and floating lights have been connected with the main telegraphic system "for life-saving purposes only." There were, at the end of 1896, 27 such stations in England and Wales, 14 in Scotland, and 11 in Ireland. The most suitable places were selected for the observation of passing vessels and for the immediate transmission of reports of casualties to the nearest points available for help. It is by no means an easy work to make a durable telegraphic connection with a lightship, and with all stations the cost is considerable; but the benefit is so marked that this communication, long and urgently demanded, will soon be extended to all other sites on the coast where the advantage is evident, and the difficulty not insurmountable.

Of the new sea lights in the decade under review may be mentioned the Girdleness, the Rattray Head, the Tarbetness, the Stromo, the Scaddon, the Skroo, and the Sule Skerry, all on the Scottish coast; and the Round Island, the St. Catherine's electric, the Spurn Point, and the Withernsea, on the English coast. The characteristics of several older lights of fixed sections have been changed, such as the Whitby, Coquet, Orfordness, Southwold, and Needles, which have been made occulting lights.

To complete the bare statistics of the subject, it may be mentioned that the whole number of lights of all sorts and sizes on the coasts of the United Kingdom on December 31, 1896, according to the Admiralty List, was 1,005, an increase of about 200 over the number of ten years ago. Of the 1,005 lights, not more than 11 or 12 per cent. may be classed as of sea power, and 6 or 7 per cent. as lightships. The rest are port, harbor and pier

Turning to the optical features of the decade, let us see what changes have affected the two main factors of illumination—the fixed light and the revolving light. The ever-increasing number of ships and ports, and the sustained demand for greater and greater speed of vessels, and for sea signals that shall serve more and more to meet all conditions of weather and to discriminate harbors and channels of approach, have stimulated the efforts of lighthouse engineers in the two directions of power and distinctiveness.

The characteristics introduced of late years have been confined for the most part to new combinations and periods of group flashes, or of single equal flashes. Mixed lights of fixed and revolving sections, and therefore with unequal degrees of visibility, are no longer in good repute, although, in the French service especially, they are still retained. Color also is being gradually abandoned for sea lights. For harbor lights, however, it is still freely resorted to, most of all in Northern Europe, as in the Ono light, Baltic Sea, where in one small apparatus there are no fewer than six characteristics with seventeen variations.

Power has been sought:

(1) By the substitution, wherever practicable, of annular for cylindric lenses, or of revolving for fixed sections.

(2) By the longer focal distance and larger condensing surface of these lenses, and by superposing them in vertical series.

(3) By using an illuminant of maximum intensity, whether oil, gas, or electricity.

(4) By certain variations and extensions of the Fresnel refractors, giving a higher coefficient of beam.

(5) By invoking the principle of the full perception of the light from an annular lens moving in rapid rotation

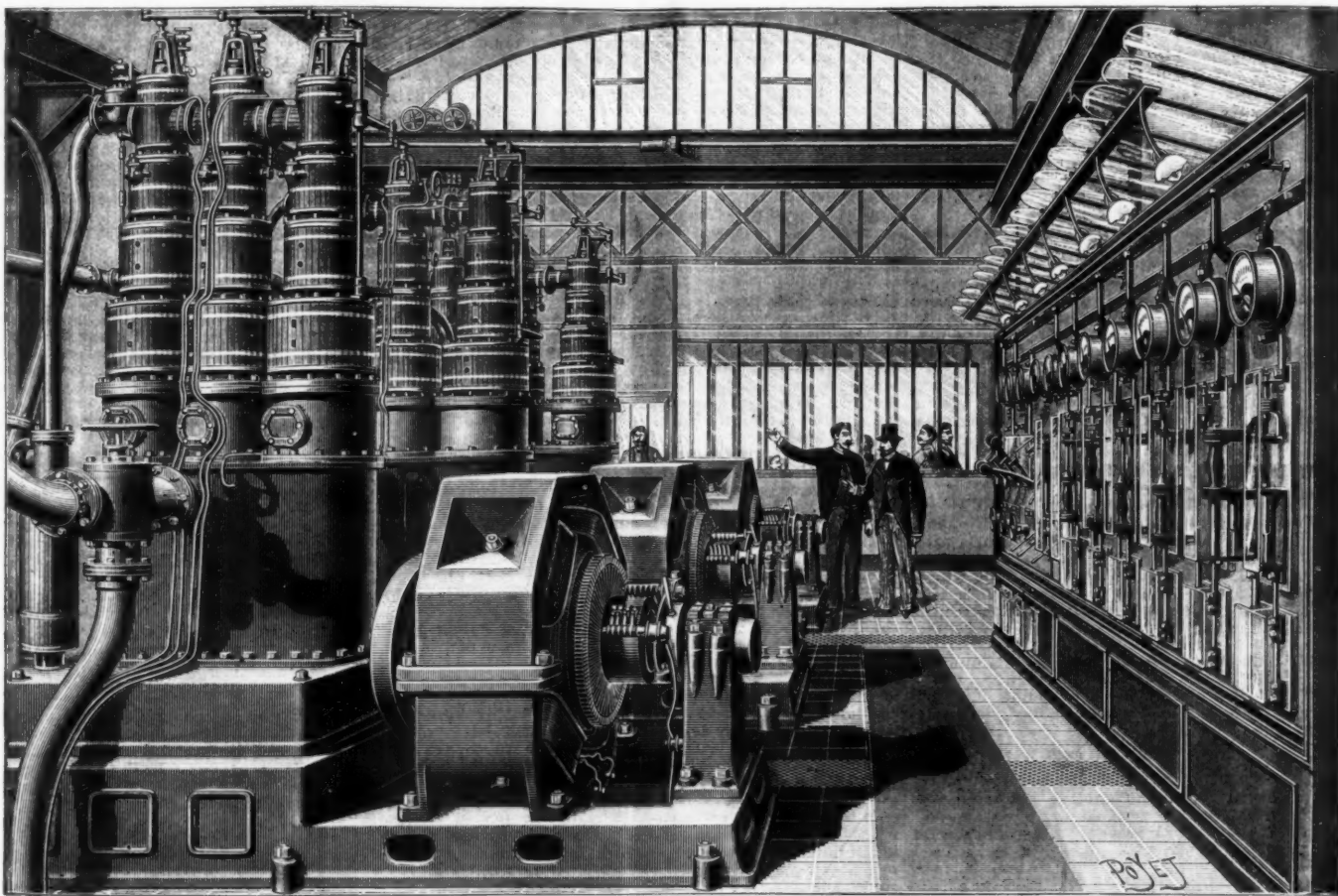


FIG. 3.—INTERNAL VIEW OF THE MACHINERY HALL OF THE WORKS FOR THE PRODUCTION OF ELECTRIC ENERGY.

sulted from the first efforts of Messrs. Chance, but they have gone on steadily and alone to the present day, with little or none of official aid or encouragement, and they are certainly entitled to full credit for having done so much and so well for the coast illumination of their own country and the world.

I adopt the main divisions of the former articles, viz., Towers, Apparatus, Lamps.

There is not much to be noted in regard to the architecture or engineering features of the iron and stone lighthouses erected in Britain during the past ten years. The principal island towers are in the Shetlands, viz., Stromo, Fair Island, and Sule Skerry, which is one of the dangerous reefs known as skerries so thickly strewn on the northern and western coasts. These all are the successful works of Messrs. D. and C. Stevenson. The Trinity House has not erected any rock or pile tower since the Round Island in 1887.

Of lightships there have been established two only, which are at the mouth of the Thames to mark the Edinburgh Channel, and, like all the Trinity lightships, they have 31 inch silverpated reflectors, with the powerful two-wick oil burners of Sir J. Douglass, the flash from one face of the light being equal to 20,000 candles.

To nearly all the light vessels in our waters sound signals, chiefly of the siren type, have been added, which are invaluable in the frequent sea fogs that beset our shores, since by a marvelous beneficence of nature—for the proof of it we are chiefly indebted to the researches of Tyndall—fog that quenches light deepens the intensity of sound. The siren is now an indispensable adjunct to our principal land lights, and a visit to the Isle of May, the St. Catherine's, or Ailsa Craig, would well repay any one desirous of seeing the latest

lights, showing a very abundant supply of local signals apart from the great coast signals controlled by the three Lighthouse Boards.

It would seem, indeed, that the programme of coast lighting is almost completed—at least as regards England. A powerful oil light is to be erected by the Trinity House in St. Mary's Isle, on the northeast coast, and two others in Lundy Isle in the Bristol Channel, where also, at Lynmouth, an electric light is proposed. A further improvement in the fine reflector light of Beachy Head is also spoken of. The Northern Commissioners will erect a first-class light at Noup Head, in the Orkneys, and another on the Flannan Islands in the Hebrides. For Ireland no new light appears to be intended for the present; but the improvement of the Fastnet, the most outlying of our lights westward, must soon be taken in hand.

The lantern which crowns the tower and protects the apparatus of a land or rock lighthouse has been materially improved in its construction. The perfect lantern is of adequate area to contain the light and accessory parts, and afford convenient space for service. Its diameter for a sea light is rather 14 feet than 12 feet. It is of circular form throughout, having a cast iron pedestal of sufficient height to carry an inside and an outside gallery for cleaning purposes. The framing is of gun metal or wrought iron. The half inch plate glass of the purest quality, while resisting wind and weather to a great extent, intercepts the least possible light from the lenses. There is provided abundant ventilation to sustain the central lamp, and refresh the keepers. The best contribution of the Trinity House to the structure has been the large cylindric ventilator on the double copper dome, by which the last named advantage is mainly secured.

with very short intervals between the flashes. This is known as the feu éclair.

(6) By rotating an opaque screen around a lamp, or by raising and lowering quickly an opaque cylinder, or by cutting off and relighting of gas in rapid alternation. Let us consider these in order.

(1) The reasons for the disuse of fixed sea lights, except in the case of marking or intensifying particular sectors, are chiefly their want of power to penetrate to their natural horizon, and the increasing number of bright fixed lights on ships and on shore, which may in certain conditions lead a navigator into danger from the difficulty of distinguishing them from a lighthouse. The flashing light, with its superior power and numerous possible distinctions, is the best safeguard against this.

(2) The hyper-radial lens of 1,330 millimeters focal distance, first suggested (as Prof. Tyndall declared) by Mr. John Wigham, and concurrently at least by Mr. Thomas Stevenson, who less fitly termed it hyper-radiant (a good name for the ten wick oil flame, or ten ring gas flame), has quite justified the expectation of lighthouse engineers as a convenient and powerful instrument admirably adapted to the large burners now employed. This lens, like its predecessor of 920 millimeters radius, is commonly used without catadioptric prisms, as in the Spurn Point light. The disuse of prisms effects a great saving in cost at but an inconsiderable diminution of power where a high vertical angle of refraction is adopted. Yet it must be admitted that this is at the expense of symmetry and elegance. The French light on Cape d'Antifer is a fine example of the hyper-radial system, embracing a full complement of prisms.

There has also been constructed, at Mr. Wigham's

suggestion, as an experiment, what he aptly calls a giant lens of 2,000 millimeters radius, but it is not yet adopted in practice.

The superposition of lens lights, each with its own burner, is an obvious means of gaining power, and it is remarkable that, although first suggested in 1859, it was not practically utilized with dioptric apparatus until 1872. Whether bifurcated, trifurcated, or quadrifurcated arrangements be resorted to, the advantage of concentrating or reducing the intensity of the beam according to atmospheric variations is inestimable, and the adaptation reflects undoubted credit on Mr. John Wigham, whose polyannular gas burner on a like plan had been already approved. The trifurcated Trinity Island light, fitted with these burners, and variable in power from 17,500 to 336,500 candles, may be cited in illustration.

(3) The maximum intensity of an illuminant must still be sought in the electric arc. Gas and oil remain substantially equal compared in lamps of the same size and sort, the superior applicability of each being determined by local conditions. In Ireland the Wigham expanding burners give a marked prominence to the gas, which is copiously used in them. In England and Scotland mineral oil is preferred, its quality being carefully maintained at the highest standard. The old disability of this illuminant, the risk of explosion, has been almost nullified by the production of a petroleum whose flashing point is 230°, and long experience has confirmed its great value. On the other hand, the gas called "incandescent" has been introduced, the best form of it being of the Auer-Welsbach type. The brilliancy of this gas is perhaps only second to that of the electric arc, but the perishable character of its accessories exacts great caution in using it, and it has not as yet been employed in any sea light in this country, although it is already so adopted in France. A mixture of oxygen and coal gas, and one of oxygen and oil vapor, which have been tried in street lamps and otherwise, have been recommended for lighthouses, but not hitherto accepted.

Electricity has been, as it were, on its trial since the South Foreland experiments of 1885, and the evidence affecting it is hardly yet complete enough to justify a final verdict. The result established at the South Foreland was that the electric light is the most powerful under all conditions of weather, and has the greatest penetrative intensity in fog. The committee of the Royal Society, which examined in 1890 this report of the Trinity House, found that the experiments did really justify the results given.

The twelve years that have elapsed since the trials at the South Foreland have on the whole tended to qualify the conclusion as to the penetrative power in fog. Three lights—two of the group flashing and one of the single flashing character—constructed by Messrs. Chance, may be cited on this point. The triple flash of the Tino light (near Spezia) has been unmistakably discerned in rain and fog at a distance of more than twenty miles. On the other hand, the Isle of May light has been invisible in a thick atmosphere not amounting to fog, at a distance of twelve miles, and in a dense fog at half a mile; and the St. Catherine's light was equally invisible to the Eider before she grounded on the Atherfield ledges. It has been, indeed, asserted that the St. Catherine's has often been unseen at a quarter of a mile distance.

The truth appears to be that the electric light is very sensitive to atmospheric conditions, which are so many and so various, and that in thick weather it parts with its power in a much greater ratio than does a gas light, or even an oil light. There is a degree of fog which quenches the sun, while the large luminous surfaces of the superposed gas lenses project on the fog a reddish coloration, and the fog itself thus becomes a signal to the mariner when, as it were, in the words of Persius, "Pinguem nebulam vomere lucernæ." It would be most dangerous, however, for the mariner in a fog to approach the coast presuming on this quality of a light in whose vicinity he supposed himself to be. The lead, the anchor, the horn, should be his trust till the veil lifts, and the electric beam shines out in full splendor.

There has occurred no important change in the burners of sea lights. The Trinity House improved six wick, or rather five wick, remains, if not the largest, the best working oil burner, with a power of 800 candles. This is used generally for lights of the first and second order, while the four wick, with a power of 360, is used for third order lights, and the eight wick, of 1,200 candles, for hyper-radial lights. The lamp is of the "pump" or the "pressure" type, and contains from 10 to 100 gallons of oil. It is probable that, owing to considerations of space and economy, the gravity system may again be resorted to with enlarged reservoirs seated on the lantern roof. The electric arc is used with carbons of from 15 mm. to 65 mm. diameter and currents of from 50 to 400 amperes. The incandescent filament is not found equally appropriate. The luminous intensities obtained from the arc range from five to fifty thousand candles. Both direct and alternating machines are employed. The installations at St. Catherine's and the Isle of May are of the most complete character, and do honor to the distinguished engineers of the Trinity House and the Northern Commissioners.

It may be mentioned that for positions difficult of access, lamps having special wicks and reservoirs for oil or gas, capable of burning from ten to thirty days, are now in use, though, of course, these are only available for small isolated lights.

(4) The improvements since 1887 in dioptric lights are few, and, with one exception, are of no striking importance. The great invention of Fresnel, perfected by the beautiful holophotal arrangements of Stevenson, has remained the cardinal principle of all modern lights of the lenticular type. But the inevitable tendency to modify and improve has resulted in several proposals of more or less merit. Mr. Alan Brebner had, in 1882, submitted an ingenious plan for producing vertical and azimuthal condensation by single agency in cases where straight prisms placed outside the main apparatus had been employed to intensify one or more sectors. This method, however, has been seldom, if at all, adopted. Again, Mr. Brebner, in 1884, had recommended a plan of dipping a portion of the beam to some intermediate distance between the lighthouse and the horizon to meet the case of a fog which the strongest beam can only very partially penetrate. This, or some analogous plan, has been tried, but has not prevailed. The advantage of withholding from the horizon a substantial part of the beam, and deflecting it anywhere,

is extremely doubtful. The depth and direction of a fog are always uncertain elements. The lighthouse may be surrounded by it while the offing is clear, or vice versa. And it would be in equal measure mischievous to encourage the mariner to stand in, looking for a signal which he might never see, or see too late; and to intrust the lightkeeper with the power to deflect the light according to his own judgment. In 1892, Mr. Charles A. Stevenson published in Nature an account of his spherical and equiangular refractors which remedy a certain loss of emergent light in the Fresnel refractors. In 1894, Mr. Stevenson further developed his design, claiming for it, within practicable limits, an advantage of at least 10 per cent. in increase of light as compared with the Fresnel lens. The improved refractors have been adopted with success in several of the Scottish lighthouses. In 1895 and 1896, Mr. John A. Purves contributed an able mathematical analysis of equiangular prisms and a new form of spherical central lens, called the inverse refractor (the facets of the lens turned inward), to be used in connection with Mr. C. Stevenson's equiangular prisms. Messrs. Chance have raised the Fresnel lens from 37° vertical to 80°, using glass of the same refractive index, and this angle has been adopted by the Trinity House with great advantage.

(5) The one exception referred to in regard to the minor improvements of optical apparatus since 1887 is the "lightning light," an adaptation of serious importance which has attracted the attention of lighthouse engineers in nearly all maritime countries. The shortening of the interval between the flashes of a revolving light, so that the mariner, especially when in a fast liner, may have more speedy cognizance of the signal that guides him, has become a plain necessity, and led to the gradual reduction of the period from 60, 45 and 30 seconds to 20, 15, 10, and even 5 seconds, reducing proportionately the duration of the flash. So far the principle of the feu éclair has been approached. But much more than this is demanded. No one has advocated more strenuously than Lord Kelvin, himself a sailor and a benefactor of sailors, the acceleration of revolving lights. No one has laid it down more clearly that one-ninth or one-tenth of a second is sufficient for the eye to receive the full luster of a lens passing it. Any longer duration is a loss of time, and therefore of intensity. German and French physiologists have confirmed this, and it is the principle on which the feu éclair system is based. In its application, then, if for any "order" of light the maximum of power be desired, the largest available lens in vertical and horizontal angle, combined with a totally reflecting mirror and a central flame of adequate dimensions, must be adopted. If two or more lenses be used, singly or grouped, the intensity of each flash is proportionately less, the interval of time, say five seconds, between the single flashes or the groups of flashes being the same as where there is only one lens. In this manner the greatest intensity and the shortest interval are secured, and the characteristic as presented to the mariner seems theoretically perfect. The first general introduction of the "lightning light" is due to M. Bourdelle, the chief of the French lighthouse administration, under whose auspices several lighthouses on the coast of France have already been endowed with it. In England Messrs. Chance have constructed, in 1895, for Cape Leeuwin, Western Australia, a "bivalve" apparatus of the first order, with an experimental duration of beam of one-fifth of a second, and they have placed, this year, in the exhibition of the Imperial Institute a "univalve," or one-lens apparatus, of the third order. Both these lights are on the feu éclair system.

Successful as this system appears to be, it should for the present be regarded as on its trial, and as awaiting the collective judgment of mariners on certain points. And meanwhile it should be estimated as supplementing, not displacing, the well tried forms of apparatus at the disposal of the lighthouse engineer.

A notable adjunct to the new rapidly rotating lights is the mercury float carriage, by which the effect of weight and friction is largely diminished. Another excellent quality of this arrangement is its suitability for stations where earthquakes prevail, as it provides an elastic connection between the optical apparatus and the pedestal, instead of the rigid bearings in the older forms of carriage. If the Curamilla lighthouse in Chile had been fitted with the mercury float, it is probable that it would not have been wholly ruined by the shock.

(6) The principle of occultation, that is, of interrupting the fixed beam of a cylindrical lens of an oil light by a dark shade moving round or over the flame, or in a gas light by cutting off the gas, is acknowledged to be of extreme usefulness, and has been applied to many of the fixed lights of our coasts. It is not that any power is really added to the light, but that the quick alternation of light and dark in various groups or periods imparts a quasi-intensity to the beam and a valuable set of characteristics for the mariner. The law of contrast has a physiological effect here, as it has in another manner with the feu éclair. It is an extreme example, but it rests on trustworthy evidence, that the occulting light of Ventotene Island, near Naples, which is of the sixth order only, has been seen from a distance of nineteen miles, its normal range being nine miles. Using the words of Cicero with another application, it may be truly said, "Eo magis elucet quo magis occultatur."

Investigations into the amount of light reflected and transmitted by certain kinds of glass—lighthouse glass among the rest—have been most ably conducted by Sir John Conroy, Bart., at Oxford, in 1888. He traversed by newer methods and with surer results the ground of many observers, from Augustin Fresnel to Lord Rayleigh; and he demonstrated that "the values of the transmission coefficients for light of mean refrangibility show that for one centimeter the loss by obstruction amounts to 2.62 per cent. with crown glass and 1.15 with flint glass." The refractive index of lighthouse glass lying between 1.52 and 1.54, the loss may thus be practically taken as 2½ per cent. for ten millimeters of thickness.

The intensities of lighthouse apparatus have of late been diligently considered by lighthouse authorities with the view of determining once for all the relative values of the six orders of lights, and of the lamps appropriate to them, and also of publishing the results in the Admiralty Light list. A large amount of uncertainty and misconception seems to have prevailed on

this question. M. Allard, in 1876, in a celebrated memoir, gave an elaborate exposition of the whole subject, but his conclusions, always tending to excess, have not been accepted by more recent investigators.

Other estimates, official as well as private, and more or less discordant, have from time to time appeared, both in this country and France. The factors of evaluation, such as radius, lens surface, vertical section, flame, reduction for losses, etc., have been combined in different ways by different persons, and some of their conclusions must be regarded as merely empirical. But in 1891 and 1892 a serious attempt was made by a committee of the chief engineers of the three lighthouse boards to compile an accurate schedule of intensities with photometry as a basis. Taken as a whole, the values arrived at are fairly acceptable, not certainly erring on the side of excess.

But as yet only the lights with oil or gas for illuminants have been determined.

Electricity appears even more difficult to deal with, and no intensities have been assigned officially to any of the electric lights in the British Islands.

Thus it is uncertain whether, for instance, we are to consider the Isle of May as of six millions of candles or of twenty-six millions, both estimates resting on competent professional authority. The lights on the feu éclair system, oil and electric, are obviously less amenable still to formulae which may give their coefficients of intensity, although French writers do not hesitate to define these, and deduce thirty or forty millions of candles as "ayant la consécration de la pratique."

It is much to be desired that as a sort of sequel to the publication of the intensities of lights—at all events, of the British lights—there should be provided a form for every vessel under the control of the Board of Trade, in which a return should be made of the appearance of every light approached or passed, with statement of the weather, distance, name and character of the light, etc. These returns, duly kept and handed to the Board of Trade on the first opportunity, would gradually constitute an invaluable record of the merits or demerits of our lights, instructive to the engineer, and through him beneficial to the mariner. I have repeatedly, but in vain, urged this expedient on the authorities.

The administration of lighthouses in this country has undergone no change in the past decade, nor, indeed, since 1861, when the royal commission on lights recommended that a central board should be constituted instead of the quadrifurcated government then, as now, in force, and gave excellent reasons for the recommendation. The further experience of thirty-six years has amply confirmed the earlier conclusions on this subject and has brought into stronger relief the example of the French administration. Some slight approach to the desired reconstruction may be indicated in the report of the committee of inquiry on the mercantile marine fund of 1890, paragraph 71, in the following words: "From the evidence brought before us, we unanimously recommend the formation of a small committee containing representatives possessing as far as possible nautical knowledge, of the Trinity House, the Scotch Board and the Irish Board, which should be summoned at least once a year to advise the Board of Trade upon the desirability of all new works, whether in respect of lighthouses, steamers, buoys or signals, together with all renewals, alterations and important repairs."

But however we may regard the system of government of our lighthouses in contrast with the French system, and desire its amelioration, it is impossible to deny that the United Kingdom has, during the Victorian era, produced men who individually have done fully as much in every part, theoretical and practical, of lighthouse science as have the distinguished men of the sister country. In one group we can point to the names of Faraday, Airy, Thomson and Chance. In another to those of Stevenson, Douglass, Hopkinson and Matthews. In yet another to those of Farrar, Nisbet, Sydney, Webb, Trevor, Wharton and Nares.

These men have enriched and illustrated lighthouse mathematics, engineering, optics, mechanics and nautical and general administration in a manner and with a success to be gratefully remembered in our day and never to be forgotten in the new developments of the years to come.—J. Kenward, in Nature.

INTERDEPENDENCY OF INVENTIONS.

THE advent of important and valuable inventions is often dependent, not upon the brilliant inspiration of some individual inventor, but upon the general and gradual advance of the state of the art to which they belong, making their occurrence not only possible, but almost inevitable. The bicycle is an excellent example of this kind of growth in mechanical construction, since, while it is one of the most important things both mechanically and commercially which has ever been produced, it owes its development to the parallel improvement in metal and rubber working, without which it could never have existed at all, in the modern sense, or to any extent. The clumsy wooden velocipede would always have remained a useless toy had not the introduction of drawn steel tubing made the construction of a light and yet strong frame possible, while the original leather tire of Dunlop could never have led to the practical application of the pneumatic principle without the substitution of the rubber construction which only the advances in rubber manufacture made possible. This is but one instance of what is apparent in many other lines of work, and there is little doubt that if the patent records of the past fifty years were thoroughly studied by competent specialists many inventions, which at the time of their conception were failures simply because of the impossibility of executing the ideas, would now be found both practicable and valuable.—Cassier's Magazine.

Bamboo is used almost exclusively for furniture. It is, however, an excellent material for making scaffolds for building. It decays neither in water nor in the earth, and is rendered harder than ever by dryness. It is also very strong in proportion to weight. Stems 4 inches thick may be used for scaffolds 25 feet high, and will bear the weight of iron beams weighing twenty hundredweight. The length of the stems, too, is a great advantage; some of them grow over 65 feet high. —Wiener Gewerbe Zeitung.

ENGINEERING NOTES.

Seven of its small and obsolete steamers have been sold by the Norddeutscher Lloyd to another Bremen steamship company for a million and a quarter marks. This sum means over thirty dollars a ton, a high price for old steamships.

It is reported that in the year 1896-97 there were seven accidents on Indian railways for every 100,000 train miles run, the number being the same as in the previous year. The proportion of passengers killed, however, was considerably greater, being one in 9½ millions, as against one in 19 millions.

On the London and Northwestern Railway alone there are 17,000 signals lighted every night, says The Engineer, and an engine driver working from Crewe to London and back for his day's work is controlled by no less than 370 signals, to say nothing of those coming under his observation which do not affect the working of his train.

The deepest pit in the world is that at Peruschowitz (Silesia, Germany), which has a depth of over 6,500 ft. below the surface. It has been found by experiment that the temperature in this pit rises by 1° Centigrade for every 148 ft., being 13° at the top and 63° at the bottom. This result agrees with those obtained in similar cases.—La Science en Famille.

Compressed air is now being used by certain American tool makers for performing the feeding, etc., of automatic machine tools, says Engineering. In a screwing machine made by the Acme Machinery Company, of Cleveland, O., the whole of the tools are thus effected. The attendant has only to place the blanks in position, when the machine does all the rest. Very rapid work is thus accomplished, some 7,300 ½ in. bolts being threaded in nine hours with a machine having two screwing heads. The same agent is used by another American firm for operating the feed motions and reversing gear of large planing machines. Shifting belts are thus avoided, with the constant wear and tear.

In regard to riveting with compressed air, the master mechanic of the Santa Fé road is quoted as saying that by the use in the Santa Fé shops of a stationary riveting machine three men are enabled to drive 2,000 rivets per day of ten hours at a cost of \$4.75, as compared with 200 rivets per day at a cost of \$7 by hand labor; the truck riveters—the machine being operated by two laborers at a total cost of \$3 per day—drive 3,000 rivets, as compared with 175 rivets driven by hand labor by three men in a day at a cost of \$6, while the staybolt breaker makes an average saving of \$3 a day and the tank riveter an average daily saving of \$10. Further, the mud ring riveters will drive as many rivets as can be banded to them and will make a saving of \$12 to \$15 a day for that class of work. Not only is this method credited with the great saving named, but it is declared to insure every rivet hole being filled entirely and insures tight work, while of hand-driven rivets in mud rings a large percentage invariably leak.

In using a graphite crucible the first step is the annealing. When the crucible comes from the kiln, where the temperature is very high, it is supposedly "bone dry." It is, however, porous, and easily absorbs moisture; hence it should always be stored in a "bone dry" place. As to annealing, both too little and too much stress can be laid on it. The best annealing is even heating. That is, evenly warm the pot, not on one side only but around the pot, to between 250° F. and 300° F., and maintain that heat there until all moisture is expelled. Nothing more is required, except equally good attention should be given to the even cooling all around the pot. The pith of annealing, according to a correspondent of The Engineer (New York), is that the crucible should be heated and cooled off evenly, and receive heat enough and no more than enough to expel its accidental moisture. If the crucible is a large one, after toasting its outside walls, set it over a black, low, slow fire, bottom side up, so that the inside walls, as well as the outside, can get the benefit of the toasting process.

According to a return just issued in the form of a blue book, more than 99 per cent. of the engines and carriages belonging to the different railway companies of the United Kingdom are fitted with a continuous brake, the brakes being not only continuous but also automatic, and constructed in compliance with all the official conditions, says The Engineer. Less than eight years ago more than 10,000 railway vehicles were fitted with brakes which satisfied only some of the demands made by the department, whereas the number has now shrunk to a little more than 30. After allowing for less than 500 vehicles having no continuous brake, perfect or imperfect, we come to a grand total of more than 65,000 carriages and 12,000 engines fitted in the manner prescribed. The extent to which the approved brakes are employed is shown in an interesting form by a statement as to the number of miles run by trains so equipped. In the last six months of 1896 the miles traversed exceeded 100,000,000, being more than 99 per cent. of the total. The Great Western and North-western trains each run more than 11,000,000 miles under such conditions.

The Norfolk and Western Railway has equipped its baggage cars with an arrangement of safety bars and hooks for supporting bicycles at the top of the car out of the way of other baggage. Wrought iron holders covered with rubber hose are fastened by screws to blocks placed between the car lines in the center of the roof. These holders are spaced in pairs 3 ft. 8 in. apart throughout. Straps are fastened to either side of the car, central with each pair of bicycle holders, and safety bars are placed across the top of the car between each set of holders and straps. In loading bicycles they are inverted, and the holders in the center of the car roof are hooked into the rims of the two wheels. The frame of the bicycle is then tilted up toward the side decks, the strap being wrapped a few times around the frame, after which its end is slipped over the hook, thus holding the wheel in place. A small stool is carried in each baggage car, by the use of which the straps are easily reached. There is provision in the long baggage cars for carrying 16 bicycles, in the short baggage cars for 12, and in the combination baggage and passenger cars for 8 bicycles.

ELECTRICAL NOTES.

England is secretly laying a military cable between Vigo Bay and Gibraltar, according to the Paris Matin.

After considerable deliberation, the tramway company of Boulogne-sur-Mer (France) has decided on the adoption of the trolley system with overhead conductors.—L'Industrie Electrique.

At Santiago (Chile) a great enterprise is planned. By utilization of the force of a waterfall the whole town is to be supplied with electric light, and the tramway system is to be installed after the present means of locomotion are discarded.—L'Industrie Electrique.

A prominent water wheel manufacturer in San Francisco, according to the Electrician, has recently contracted with a Kobe firm to supply three 500 horse power Pelton impulse water wheels, to be operated under a head of 260 feet. The water wheels will be direct connected to General Electric generators, which will furnish power for an electric railway in Kobe. The contract was secured in the face of severe competition with prominent German and other European firms.

The electric colored fountains at the Brussels Exhibition are now working satisfactorily. The installation is hidden underneath the reservoir, and there are some forty-eight hand projectors used. These throw the light vertically upward through openings which are glassed over. The central space is surrounded by lead pipes, from which 150 jets throw the water to a height of from 7 to 8 yards. These being lit up from underneath by different colors alternately blending, produce an ever varying effect with brightest hues.

Electric Power for Weaving.—At present 1,200 looms at St. Etienne are driven by electrical power, distributed by the company there. The charge is \$3 per month, and it is found that hand looms, after conversion to suit them for electrical power, can produce 25 per cent. more work, with a great lightening of labor. The success of this scheme, says The Engineer, suggests the possibility that cheap electrical power in this and other countries may be the means of enabling aged and weak persons to undertake work in their own dwellings.

An electric system of railway signaling, invented by Mr. W. S. Boulton, which is now being tested in daily working on the Manchester, Sheffield and Lincolnshire Railway, near Dinting station, promises to be of great importance. It is, says the Builder, a very simple one. An electro-magnet on the road actuating two needles in a box below the engine, and each of them completing a circuit, works two miniature semaphores in front of the driver, and at the same time rings a bell. The signalman is thus enabled to have direct communication with the driver and guard even when the train is at full speed. If this system stands the test of further experience, it will make semaphores and colored lamps superfluous and do away with the present barbarous system of fog signaling.

At the Société de Biologie, at Paris, Dr. Luys read a paper describing experiments made by him, showing the presence of luminous emanations which surround the human body, and he demonstrated it in the following manner, says the Electrical Engineer: In the dark room, place your fingers for about twenty minutes on an ordinary photographic plate which is itself in a bath containing the usual solution of hydroquinone, and after this exposure fix the negative in the usual way. You will see not only your fingers and the lines on the skin reproduced, but also their pores, and, what is still more interesting, round the fingers a sort of zone or halo a third of an inch wide, which would lead one to believe that we live in a luminous fluid, which has enabled us to obtain a photographic print of itself and of the fingers, as if under the influence of light. Dr. Luys has tried the same experiment, but without any results, on patients whose hands were paralyzed, benumbed or insensible to touch. No image appeared on the plate.

W. Toritch & Co., of New York City, have been advised that an electrical exhibition is being planned by the Russian Electro-Technical Society, to take place in St. Petersburg the early part of 1899. Everything pertaining to electricity will be admitted. This will give an opportunity to introduce in Russia, they say, a number of American manufactured goods in the electrical line which heretofore were unknown in that market. The exhibition buildings will be put up in the center of the city. In the surrounding canals electric yachts will ply. Different systems of electric railroads, suspended as well as on sleepers, will be built, and also electric elevators and moving platforms. Some of the buildings put up at Nijni Novgorod for exhibition purposes will be taken to St. Petersburg. At the close of the exhibition some of the principal exhibits will be retained to form an electrical museum in St. Petersburg. Several millions of rubles, which will be necessary for the expenses of the exhibition, will be furnished by the Russian government, the city of St. Petersburg, and by the Electro-Technical Society of that city.

A new cable recorder, invented by M. Ader, is described in La Nature of July 24. It consists essentially of a fine wire stretched vertically in a magnetic field created by a strong horizontal electro-magnet, the poles of which surround the wire. The currents from the cable traverse the wire, which moves to the right or left—that is, toward the north or the south pole of the electro-magnet—according to their direction. A shadow of the wire is projected across a slit, behind which a band of photographic paper travels. A black spot thus falls upon the paper, and as the wire moves to the right or left the movements are traced upon the photographic paper by the shadow of the spot, the result being a record similar to that given by the siphon recorder. The paper is developed automatically in three baths contained in a small dark chamber, and the signals are shown in white upon a black ground. As to the speed obtained, 350 letters a minute, that is, about seventy words, have been recorded through the cable between Marseilles and Algiers, and 150 letters per minute have been recorded upon the Brest-New York cable, the transmitter being at St. Pierre-Miquelon and the receiver at Brest.

SELECTED FORMULÆ.

Remedy for Ants.—Many ways of getting rid of ants have been suggested, but few work satisfactorily. The following, however, has stood the test very well. Lay on a plate, accessible to the insects, several slices of raw meat, exposing as great a surface as possible. Let these stand for some hours, and you will find them crowded with ants, as they greatly relish raw meat. Now throw the whole into fire or boiling water. Repeat the same process, if necessary, till you are no longer troubled.—Science en Famille.

Plate Backing.—Plate backing to prevent halation may be prepared from:

Paraffine wax.....	30 parts.
Olive oil	20 "
Light lampblack.....	10 "

Let these melt in gentle heat and apply with flat brush. Before development remove with a knife.

In case of emergency a piece of gelatino-chloride paper, printed to redness, and washed free of silver may be used for backing a plate.—Revue Scientifique.

Lead Paper.—To prepare a lead printing paper proceed as follows: Lay some coarse drawing paper (such as contains starch) on an 8 per cent. potassium iodide solution. After a moment take it out and dry. Next, in the dark room lay the paper face downward on an 8 per cent. lead nitrate solution. This sensitizes the paper. Again let dry. The paper is now ready for printing. This process should be carried on till all the detail is out in a grayish color. Then develop in a 10 per cent. ammonium chloride solution. The tones obtained are of a fine blue black.—Revue Scientifique.

Protecting Iron from Rust.—Iron may be protected against rust by the use of potassium bichromate. A concentrated solution of this substance is brushed over the metal, which, when dry, is heated for some two minutes in a furnace or over a coal fire. The heat reduces the chromic acid, and produces the result desired. To test whether the heating has been carried far enough, rinse the iron with water; if the water is colored, the article must be further heated. If the heating is carried on to excess, the article is covered with a fine black coat.

Putz Pomade.—Many formulas have been published for the production of "pomades" for cleaning and polishing metal. It is said that the well known article sold as "putz pomade" consists of Armenian bole, made into a paste with oleic acid and nitro-benzol enough to give the mixture an odor. The term "putz," it may be explained, is a German one for "cleaning."

J. W. Colecord has proposed the following formula for a paste of this kind:

Oxalic acid.....	1 part.
Peroxide of iron (jewelers' rouge).....	15 "
Rottenstone	20 "
Palm oil	60 "
Petrolatum.....	5 "

Pulverize the acid and the rottenstone and mix thoroughly with the rouge. Sift to remove all grit, then make into a paste with the oil and petrolatum. A little nitro-benzol may be added to scent the mixture.—Drug Circular.

Cement for Leather Belting.—The importance of suitable cement for making joints in leather driving belts has led the Society of Chemical Industry to indorse the following formula: First, equal parts of good hide glue and American isinglass, softened in water for ten hours, then boiled with pure tannin until the whole mass is sticky, the surface of the joints to be roughened and the cement applied hot; second, one kilogramme of finely shredded gutta percha digested over a water bath with 10 kilogrammes of benzol until quite dissolved, when two kilogrammes of linseed oil varnish are stirred in; third, one and a half kilogrammes of finely shredded India rubber are completely dissolved in ten kilogrammes of carbon bisulphide by heating, and while hot one kilogramme of shellac and one of turpentine are added, and the solution heated until the two latter ingredients are also dissolved; fourth, one kilogramme of the best glue is dissolved at a moderate heat in one and a half kilogrammes of water, and thickened to the consistency of sirup. One hundred kilogrammes of thick turpentine and five grains of carbolic acid are carefully stirred in while hot; the mixture to be poured into flat tin pans and allowed to cool, then cut into pieces and dried in the air. The cement is made liquid with a little vinegar and applied to the joint with a brush; this being done, the two ends of the joint are properly placed together and thoroughly pressed between two iron plates heated to a temperature of about 86 deg. Fah.—Exchange.

Mountant for Photographs.

Gelatine.....	16 parts.
Glycerine.....	1 "
Water.....	33 "
Methylated spirits.....	12 "

Let the gelatine soak in water till it is well swollen, then dissolve by the application of gentle heat, and, stirring vigorously, pour in the alcohol in a thin stream. Use warm.—Cosmos.

Bronze for Copper.

Dissolve in 200 parts of water:	
Copper subacetate	25 parts.
Copper carbonate.....	25 "
Ammonium chlorhydrate.....	45 "
Acetic acid	10 "

In this solution boil the article to be bronzed. Use copper vessel (not tinned).—Cosmos.

Remedy for Insomnia.—A simple and harmless remedy against nervous insomnia consists in laying a moist cloth on the neck.—Der Stein der Weisen.

Ashes for Lawns.—Ashes strewn on lawns prevent the growth of moss and promote that of the grass. Soot, which is often thrown away, is an excellent fertilizer, particularly for grass, onions, potatoes, and all kinds of radishes. Both ashes and soot have the property of keeping away sand fleas and little snails. An excellent fertilizer is obtained by mixing nine parts of soot with one of salt.—Der Stein der Weisen.

HAGENBECK'S PANORAMA OF A NORTHERN SEA.

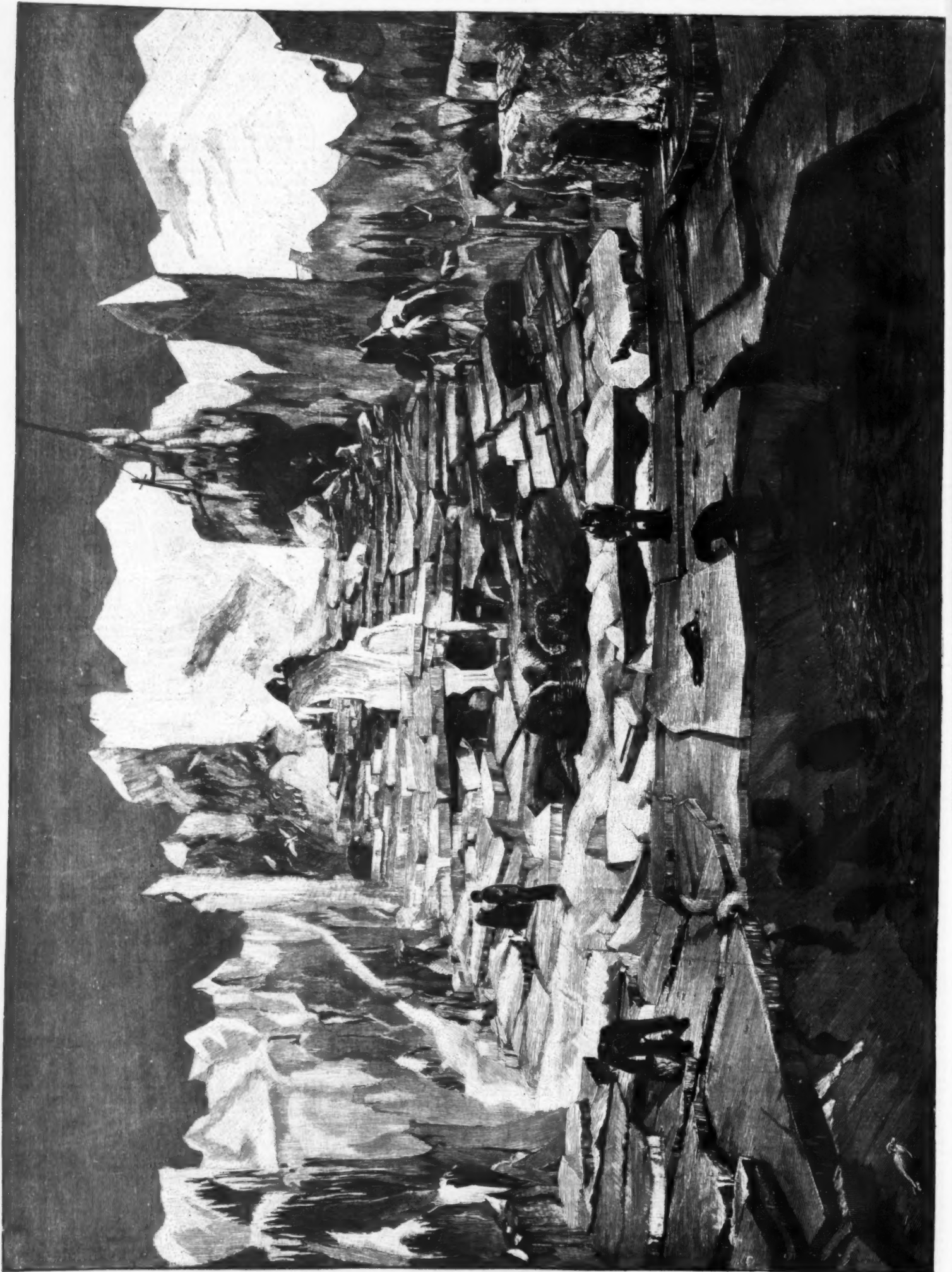
THE vivid interest in the regions far north, which was so remarkable in days gone by, has recently been

of ice, and animated with fearful polar bears and inoffensive seals, a scene from the land where so many explorers have succumbed in battle with a great and dreadful foe.

But a more concrete representation than these fan-

animals, has, by the aid of painter and sculptor, constructed an artistic panorama of a northern sea, and has added a novel charm to it by animating the scene with live beasts.

On entering the panorama the visitor is ushered into



stirred anew by the successful efforts of Nansen and Andrée's daring enterprise. In anxious suspense the whole world awaits the time when news from the aeronaut will be received, and our imagination figures up before our eyes a picture of desolate, snow-covered plains, beset with huge and shapeless blocks

of ice, and animated with fearful polar bears and inoffensive seals, a scene from the land where so many explorers have succumbed in battle with a great and dreadful foe. Transplanted, as if by a magician's wand, from regions of perpetual snow into our temperate zone, a scene of Arctic life is laid amid the busy life of the great Hanseatic town of Hamburg.

Charles Hagenbeck, the well known dealer in wild

animals, has, by the aid of painter and sculptor, constructed an artistic panorama of a northern sea, and has added a novel charm to it by animating the scene with live beasts. On entering the panorama the visitor is ushered into an ice grotto, from which he looks on the Arctic landscape. On his right and left great icebergs of extravagant shape rise from the ground. Their forms bound the horizon on either side. In the foreground the sea is covered with blocks of ice, which, in some places, have glided on one another, forming heaps, and in one

WHEEL MOULDING MACHINE.

of functions of a complex variable, in regard to some of the ways in which it is providing new methods in applied mathematics, I shall deal with it quite briefly now. The theory was, in effect, founded by Cauchy; but, outside his own investigations, it at first made slow and hesitating progress. At the present day, its fundamental ideas may be said almost to govern most departments of the analysis of continuous quantity. On many of them it has shed a completely new light; it has educed relations between them before unknown. It may be doubted whether any subject is at the present day so richly endowed with variety of method and fertility of resource; its activity is prodigious, and no less remarkable than its activity is its freshness. All this development and increase of knowledge are due to the fact that we face at once the difficulty which even the schoolboy meets in dealing with quadratic equations, when he obtains "impossible" roots; instead of taking the wily x as our subject of operation, we take the still wiler $x + y\sqrt{-1}$ for that purpose, and the result is a transfiguration of analysis. In passing, let me mention one other contribution which this theory has made to knowledge lying somewhat outside our track.

During the rigorous revision to which the foundations of the theory have been subjected in its re-establishment by Weierstrass, new ideas as regards number and continuity have been introduced. With him, and with others influenced by him, there has thence sprung a new theory of higher arithmetic; and with its growth, much has concurrently been effected in the elucidation of the general notions of number and quantity. I have already pointed out that the foundations of geometry have had to be reconsidered on account of results finding their origin in the theory of invariants and covariants. It thus appears to be the fact that, as with Plato, or Descartes, or Leibnitz, or Kant, the activity of pure mathematics is again lending some assistance to the better comprehension of those notions of time, space, number, quantity, which underlie a philosophical conception of the universe. The theory of groups furnishes another illustration in the same direction. It was begun as a theory to develop the general laws that govern operations of substitution and transformation of elements in expressions that involve a number of quantities; it soon revolutionized the theory of equations. Wider ideas successfully introduced have led to successive extensions of the original foundation, and now it deals with groups of operations of all kinds, finite and infinite, discrete and continuous, with far reaching and fruitful applications over practically the whole of our domain. So one subject after another might be considered, all leading to the same conclusion.

I might cite the theory of numbers, which has attracted so many of the keenest intellects among men, and has grown to be one of the most beautiful and wonderful theories among the many in the wide range of pure mathematics; or, without entering upon the question whether geometry is a pure or an applied science, I might review its growth alike in its projective, its descriptive, its analytical, and its numerative divisions, or I might trace the influence of the idea of continuity in binding together subjects so diverse as arithmetic, geometry, and functionality. What has been said already may, however, suffice to give some slight indication of the vast and ever widening extent of pure mathematics. No less than in any other science, knowledge gathers force as it grows, and each new step once attained becomes the starting point for steady advance in further exploration. Mathematics is one of the oldest of the sciences; it is also one of the most active, for its strength is the vigor of perpetual youth.

CUINAT'S ACETYLENE GAS GENERATOR.

In the acetylene gas generators in which the water falls upon the calcium carbide there are several serious difficulties to be avoided, the greatest of which is overproduction. When the carbide is fresh, the disengagement of the gas is proportional to the quantity of water introduced, but, inasmuch as the liquid first saturates the lime that envelops the carbide before coming into contact with the latter, the proportion of the discharge is no longer theoretical. At the stoppage of the flow, the excess of water thus introduced causes the subsequent decomposition of the carbide, since, in cooling, the lime liberates a portion of the water that it has absorbed. It is therefore either necessary to arrest the normal operation of the generator before suspending that of the consumption apparatus or to allow the gas produced in excess to escape into the air with every precaution possible. There is to be feared, too, an elevation of the temperature resulting from the reaction of small quantities of water in a relatively large mass of carbide.

An endeavor has been made to overcome such difficulties in many ways. Certain inventors throw the carbide into the water, while others introduce it at the bottom of the carbide receptacle, where it progressively ascends.

It is to this category that belongs the generator devised by Mr. Cuinat, and represented herewith. Its arrangements are such that the production of acetylene is absolutely independent of the greater or less regularity with which the friable mass of the residue settles. Were it otherwise, the level of the water might undergo abrupt changes capable of causing an irregular production of gas.

Two distinct receptacles contain the water and the carbide. According to the size of the apparatus, the water reservoir either surmounts the gasometer (Fig. 1) or the carbide receptacle, with which it in both cases is connected by a conduit provided with an ordinary cock at the top and an automatic one at the bottom.

The carbide of calcium is not stored up in a mass, but is distributed in layers of slight thickness. Each of these latter is contained in a circular basket consisting of a solid iron plate disk riveted to a ring about 22 mm. in height, the periphery of which is provided with numerous apertures. These baskets are superposed in their common receptacle, which is capable of holding twenty of them connected in groups of four by means of a couple of pins. These baskets are of variable dimensions, which are so determined that the carbide of each of them shall disengage a volume of acetylene just sufficient to fill the holder of the gasometer. In the type capable of supplying 43 burners consuming 20 liters an hour for five hours, each con-

tains 750 grammes of carbide. After they have been charged, they are piled up in the generator, which is then closed by means of a cover held either by a bridge and bolt (Fig. 1) or by a series of thumb nuts that can be rapidly maneuvered (Figs. 2 and 3).

From the top of this receptacle starts a large conduit that connects with a tubulure fixed to the bottom

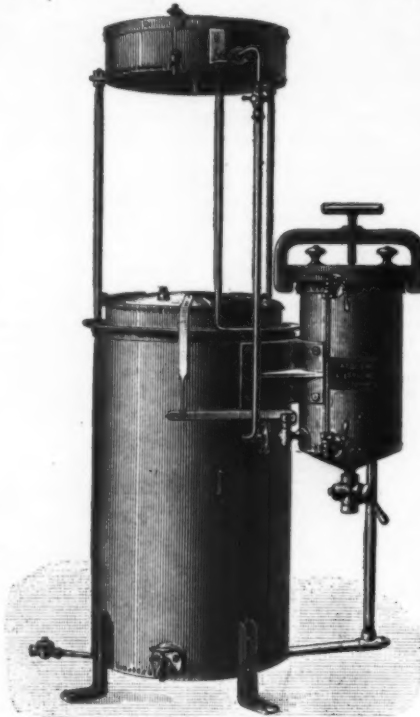


FIG. 1.—CUINAT'S ACETYLENE GAS GENERATOR.

of the tank of the gasometer and prolonged by an ascending conduit whose upper part is curved so as to plunge to a slight depth into the water of the tank.

When the apparatus is set in operation, the holder of the generator occupies its lowest position. A tappet fixed to its dome then rests upon the jointed lever of the automatic cock established at the foot of the water pipe and holds it open. As soon as the upper cock is opened the apparatus begins to work.

The water entering the carbide receptacle deluges the contents of the first basket. A chemical reaction at once occurs and the acetylene becomes disengaged and flows to the gasometer, whose holder rises progressively and, at the same time, liberates the lever of the automatic cock, which, under the action of a spring established around the key, gradually closes. The complete shut-off occurs at the moment at which the holder reaches such a position that the subsequent disengagement of acetylene suffices to complete the filling of it at a normal pressure. In this way, there enters each time into the generator properly so called

only the quantity of water necessary to cover a single basket, the contents of which correspond to one filling of the holder. All the baskets of the upper rows remain untouched. In truth, the aqueous vapor disengaged is capable of causing a beginning of decomposition of the carbide that it holds in reserve; but the arrangements provided limit the action of this vapor in a large measure. In fact, as the carbide is compressed between solid disks the vapor can hardly come into contact with it except through the apertures in the side of the basket.

Experience has shown that such precautions are very efficacious. In fact, all overproduction and, consequently, all danger of explosion are prevented. We have found on several occasions that gas generators of this system can be arrested in their operation at any moment without giving rise to an appreciable elevation of temperature.

By reason of its avidity for water, calcium carbide constitutes the desiccative par excellence of acetylene; so that the outlet pipe, which is a little above the maximum level that the water in the gasometer tank assumes, ends at a large vertical cylinder filled with carbide that is traversed by the gas before it flows to the apparatus where it is to be used.

In measure as the acetylene disappears from the holder, the latter descends. Its tappet soon meets the lever of the automatic cock and causes it to open progressively. A definite quantity of water enters anew and covers the carbide of the second basket, and the acetylene produced fills the holder again. Upon the gas generator (Fig. 1) there is a water level indicator by means of which the row of the last basket exhausted, and, consequently, the charge of carbide remaining disposable may at once be recognized.

The funnel shaped bottom of this receptacle facilitates the expulsion of the residua through a central mud cock. If one has two sets of baskets at his disposal, the recharging of the gas generator may be done very rapidly.—Revue Industrielle.

DR. MOUNT BLEYER'S TREATMENT FOR CONSUMPTION BY ELECTRICITY.

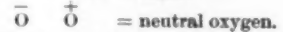
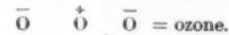
On the application of the principles underlying these experiments in the sterilization of lung tissue in tuberculosis.

The primary action of the galvanic current—It increases the amount of ozone in the blood, as shown by chemical test of the blood in the arteries—With my theory of animal electricity.*

By J. MOUNT BLEYER, M.D., F.R.A.M.S., LL.D., New York City.

SCHÖNBEIN, in drawing his conclusions regarding the nature of ozone, assumed that oxygen was capable of three distinct conditions, viz., ozone electro-negative, antiozone electro-positive, and neutral oxygen, which, as its name indicates, had no polar distinction, but could be polarized and depolarized at will.

Of these three so-called forms of oxygen, the investigations of the observers since the day of the great Basle chemist have much changed our views. To-day we admit the existence of only two forms of oxygen—ozone and neutral oxygen; and for the sake of elucidation, I give you the graphic construction of the molecule as I believe it to be:



Assuming, as he and the after-coming observers did, * Read before the Twelfth International Medical Congress, Moscow, Russia, August 19, 1887. By special invitation.

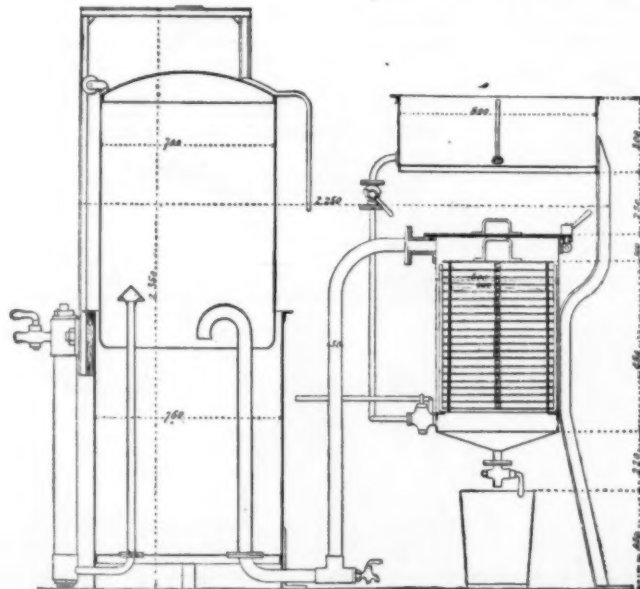


FIG. 2.—VERTICAL SECTION.

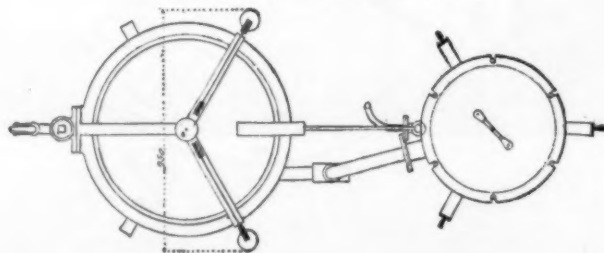


FIG. 3.—PLAN.

that oxygen in its free state was neutral—and it so proved to be—he reasoned—and it is within the pale of all researches, even up to our own time—that as soon, or rather, as I have found it, just before, this oxygen enters into combination with either organic or inorganic substances, in the presence of moisture it becomes polarized.

Carrying these conclusions into the field of physiological chemistry, he became convinced that the corpuscles, like phosphorus, were possessed of the power of polarizing the oxygen in the lungs, and further of splitting up the molecules and rearranging them in the form of ozone. His idea was that ozone existed in the blood, that it was the vital oxidizing agent by means of which the recuperative changes in the tissues were brought about; yet the years of careful work he devoted to searching, failed him in finding the slightest trace of ozone in the blood.

In his later years he became equally emphatic in his assertion that the resolution of ozone, its oxidation, was so rapid that the blood and the moistened tissues surrounding the capillaries, where the real respiration is accomplished, it would be next nigh impossible to chemically detect the presence of ozone by the most delicate test. He even went so far as to doubt its existence in the blood, that is to say, he believed that it was ushered into existence, and was used up in performing its function so quickly that it was not possible to chemically isolate it; that in the blood of the capillaries—presumably the radicals, although he does not so put it—where the pressure conditions are such as to allow of the free interchange of the gases of the blood with the tissue elements, ozone no longer existed.

Like many other great minds, Schönbein was right in many of his claims, but in many other of his theories he allowed himself to fall into error; for, in justice to those who came after him, to study this question of the physiological significance of ozone, and with no discredit to his greatness, Schönbein left much to be cleared up and explained. The ever changing and improving chemical facilities and knowledge made this task far more easy. With the advantages afforded by the chemistry of his day, Schönbein accomplished an herculean task. That famous physiologist, His, who had grown up in the shadows of Schönbein's laboratory and influence, also failed to discover the existence of ozone in the blood.

At the very time His was engaged in his futile efforts, Alexander Schmitt was at work upon the same question—ozone in the blood.

I need not rehearse the details of Schmitt's methods. Suffice it to say his experiments were elaborate and carefully made, and showed beyond doubt that ozone existed in the blood, but the quantity apparently was very small.

Not long afterward, Kühne, improving on Schmitt's tests, proved that ozone existed in the blood in readily appreciable quantity, and the question was forever settled in the affirmative.

Kühne concluded, and his deductions were not far from approximating the truth, that the red corpuscles greedily absorb ozone under the natural formation of carbonic acid and decompose water as free oxygen is liberated.

Any experiments on the blood with the galvanic current are in a line with those of Kühne and Schmitt, only a short step in advance of those observers, a mere completion of their unfinished tasks. Whatever value the results I have obtained may have, there can be no doubt that the galvanic current applied to the living body, whatever else its action may be, increases the amount of ozone both in the corpuscle and the plasma.

Before entering into a rehearsal of the details of my experiments, let me briefly touch upon the physiology of the blood, the function of its gases, for here it was that I suspected the seat of first physiological action of the galvanic current, and here, too, I was led to trace to its source animal electricity, and observe its function, as I suppose it, in the human economy.

THE BLOOD—ITS GASES AND SOLIDS.

The gases in the blood, the carbonic acid, the nitrogen and the oxygen, which interests us in particular, need not be gone into at length.

The oxygen in the blood exists in two forms—first, that which is held in solution by the plasma, and second, that which enters into combination with the constituent elements of the corpuscle.

The first variety commands our attention for the reason that to all appearances the galvanic current first acts upon this freely dissolved oxygen, and which naturally, therefore, first undergoes the transforming change from O_2 into O_3 .

With a single exception, that of defibrinated blood, the blood obeys Dalton's well known law of the absorption of gases by liquids. In vacuum 100 volumes of blood give up a trifle over 72 volumes of gas, of which in arterial blood 20 volumes upon analysis consist of oxygen, while in venous blood the volumes are reduced to between 8 and 10.

The plasma simply holds the oxygen in solution, while the hemoglobin, which by actual weight makes up 90 per cent. of the dried corpuscle, enters into partial combination with the oxygen, although I have observed, and the observations are in keeping with those of other observers, that the oxygen in the hemoglobin is in such a loosely combined state that it readily solves its bonds of union, and under the slightest provocation goes over to the other elements for which it has affinity as soon as the pressure conditions of the plasma are changed so as to permit of a loosening of its bonds.

Plasma, or to be more accurate, fresh serum, will upon exposure to the air absorb no more gas than ordinary water under similar conditions, some three volumes; defibrinated or whipped blood, however, contrary to what might be expected, takes up considerably more. This will suffice for the behavior of the gases of the blood; now a word about its solid constituents.

In general, in the plasma there are serum, albumen, globulin and crystallizable, fatty and nitrogenous matter, which, as I shall endeavor to show, are rendered more diffusible by this very transformation of oxygen into ozone, either caused by the polarizing action of the existing animal electricity of the body, or may be rendered more so by the action of the galvanic current.

In the larger vessels, for example, the carotid artery, which I have chosen as the seat of my experimentation, not only because it is accessible and convenient, but rather because it is a direct branch of the aorta, where both the plasma and corpuscles are equipped with all the oxygen they can carry, the blood is charged to its full capacity with these elements, which it is commissioned to give up to, and upon which the tissues depend, particularly oxygen.

All physiologists agree that in these large vessels carrying arterial blood the hemoglobin in the corpuscle is in the form of oxyhemoglobin, which signifies simply that the hemoglobin has entered into partial combination with as much oxygen as it can hold, and that it is ready to transfer this oxygen to the tissues as soon as the oxygen of the plasma has become exhausted and the pressure conditions become so reduced as to permit the giving up of the gas.

This occurs in the capillaries. Until these are reached the pressure of the oxygen in the plasma restrains the hemoglobin from giving its oxygen. Here in the liquid moistening the fibrillae of muscle that surround the terminal capillaries, where the transfer of oxygen in reality begins, the tension of the oxygen is almost nil, since the tissue elements are steadily taking up the gas from the lymph surrounding them, and the plasma continues to give up oxygen through the walls of the capillaries, until the tension falls too low for it to longer do so; then it is that a portion of the oxygen of the hemoglobin is freed and is dissolved in the plasma to take the place of that oxygen which it has given up and which, in turn, has passed out into the lymph on the other side of the capillary wall. This interchange continues until the pressure of the oxygen in the lymph equals that of the oxygen in the plasma, by which time the venous system of capillaries of the return circulation has been reached.

One of the strong indications of the action of the galvanic current on the blood is the probability that it facilitates this transfer of oxygen to the tissues in active form, both chemically and physically. By rearranging the atoms of some of the molecules of oxygen in the plasma the volume of the oxygen held in solution is reduced, and the oxygen of the hemoglobin is at once transferred to the plasma instead of being doled out, as it were, to suit the constantly varying pressure changes that go on as the blood completes its circulatory round. This being the case, the transforming process is undoubtedly ushered into existence through the polarizing property of the animal electricity, of which I shall speak further on.

How far chemical change is brought about upon the diffusible solids of the blood by the generation and presence of such an increased amount of ozone I am unable to make precise answer, and I leave it to the thoughtful investigation of those observers who may take interest in my work and who are blessed with a more acute knowledge of physiological chemistry and a more completely equipped laboratory than it is my good fortune to possess. To my mind there seems little question of the occurrence of just such a change as I have described. My analyses thus far have remained within the sphere of quality; it remains for others to continue in the more exact line of quantity. Reasoning by analogy, the galvanic current acts precisely upon the oxygen in solution in the plasma as it did in the jar filled with O_2 through which Schönbein passed the current and observed its transformation into ozone.

There is but one possible action of the ozone in the blood. It must hurry on the transfer of the oxygen to the tissues; call into existence the oxidation of those constructive elements which the tissues require for their revivification. Doubtless these changes are more extensive than I have been able to determine exactly.

OTHER FACTORS TO BE CONSIDERED.

The experiments of Gay-Lussan should teach us a valuable physiological lesson. From his laboratory we feel that we can carry them over to that storehouse of chemical energy, the human body, and observe changes corresponding to those he observed in his jars filled with gases possessed of great affinity for each other, which, however, remained quiescent and inactive until he prodded them with the stimulus of a galvanic current, which, as it passed through the gases, spurred into action, or awakened, as it were, their slumbering affinities, polarized their molecules, and ushered into life the new something, the result of the three great potent factors, polarization, chemical action and affinity. I have tried to impress upon you the importance of these three conditions, for upon them depend all the chemico-physiological changes, in short, all changes that go on within the human body.

I have observed them time and again in the course of my experimenting and have subjected them singly and together to the most rigorous test of verification.

My observations point to the one conclusion, and that is that chemical action, the feeder of life, cannot go on unless there is present an electrical force, an energy that can polarize the molecules of the combining elements, and prepare them for combining action. Affinity, catalysis, the phenomena of contact, in themselves are impotent without that ever preceding factor—molecular polarization.

It is the metabolism, the anabolism, the katabolism, the all, and more were it possible, of that cardinal nourisher of tissues, that feeder of life, the Blood.

Animal electricity and the important part it plays, I will reserve for a later chapter and pass over to general details of my experiments upon the blood of the living animal in its normal state and under the stimulus of the galvanic current.

(To be continued.)

THE INFLUENCE OF LIGHT ON THE SKIN.

In the July number of the British Journal of Dermatology Dr. Robert L. Bowles states that he has for many years been engaged in investigating the effects of sunlight on the human body, and especially the penetrating effects of rays reflected from snow and other surfaces. Professor Roentgen, he says, finds that certain rays generated or excited by electrical action penetrate most of the human tissues and other substances, and are stopped by substances of a different nature. The author, on the other hand, has demonstrated that reflected luminous or photochemical rays also penetrate the human skin into the deeper tissues

beneath and produce within them great and important changes. He gives the following summary of facts and conclusions of various phenomena observed by him from time to time:

1. That heat qua heat is not the cause of sunburn.
2. That there is strong reason for believing that sunburn is caused by the violet rays or ultra-violet rays of light reflected from snow, and that it is not necessarily of the same quality as that which is incident.

3. That Captain Abney finds that the violet or ultra-violet rays are very strong at high altitudes, and believes that altitude has much to do with sunburn.

4. That altitude alone does not explain sunburn; for one may be unburned on rocks, say at ten thousand feet, and yet become immediately affected on descending to a glacier three or four thousand feet lower.

5. That sunburn and snow blindness arise from similar causes, and that sunstroke and sun fever may be associated with the effects of penetrating light rays.

6. That rays from the electric light produce much the same results as sun rays reflected from snow.

7. That the bronzing of the skin and the browning of the wooden chalets are probably produced by rays reflected from snow.

8. That various pigments, but chiefly those containing red and yellow, stop or alter reflected rays and prevent the physiological and pathological changes usually due to them.

9. That freckles, which are but the milder effects of luminous or chemical rays, stop the penetration of those rays through the skin.

10. That the sometimes very serious inflammatory changes in sunburn and in what Mr. Hutchinson designates "summer eruptions" are due to the penetration of reflected luminous or photochemical rays through the skin to the deeper tissues beneath.

11. That photography often demonstrates the existence of freckles and, report says, various eruptions deep in the skin which are perfectly invisible to the naked eye, showing that the luminous or photochemical rays are stopped or altered by them, and not reflected back, as no change is produced on the negative—an effect which suggests that these photogenic rays have penetrating powers as yet unknown.

12. That the wood of Swiss chalets is burned perfectly black (carbonized) on its surface by rays reflected from snow, which rays in time penetrate deep into the substance of the wood and change it to a dark-brown color.

13. That the first effect of snow rays on a new chalet is shown by its action on the resin of the wood, which "sweats out" and leads more easily to the charring of the woody fiber itself and the subsequent changes in the deeper parts.

14. That Captain Maude, R.E., has shown from his own personal experiences and from experiments on many friends, that solar rays in India produced sun fever of a very serious kind, which was entirely prevented by the wearing of an orange lining to all his clothes and inside his hat. These experiments demonstrate the penetrating power of light rays through clothes unprotected by color, and their important influence on health. In relation to this, the author has shown that a lady wearing a linen blouse with red and white stripes was strongly marked with red and white stripes on her shoulders, but the red line on her skin corresponded with the white lines of the linen—that is, the red stripes had completely stopped all rays from affecting the skin beneath them.

15. That the author has often shown that rays reflected from certain surfaces—such as water, gold and silver lace, white walls, white veils, certain clouds and mists—act physiologically in a peculiar manner and quite differently to direct light, and that some physical change hitherto unexplained must take place in light during or after reflection.

16. That in relation with the foregoing are those marvelous changes in the vegetable kingdom connected with the formation of chlorophyll and the deposition of starch.

From these and many other observations Dr. Bowles says that he cannot help feeling that Roentgen rays may be modifications only of ordinary light, and that their further elucidation must go hand in hand with a further inquiry into the profound changes caused by reflection to which he has above referred. It need not necessarily be assumed, he thinks, that what we call darkness implies an absence of all the forms of light.

In August, 1896, the author, assisted by Mr. Travers, undertook some experiments to discover the cause of the radiant energy from snow being so much more irritating to the eyes and skin than direct energy from the sun, as follows:

1. To show the relative values of sunlight and snow-light in freeing iodine from its combination with hydrogen.

2. To test the relative effects of sun on xxx Paget's plates, inclosed in cases made of aluminum and cardboard, in producing pictures like those of Roentgen.

These exposures, says Dr. Bowles, were effected on snow at an elevation of eight thousand and forty feet, near the hut of the Ober Alpeh Glacier, on three consecutive days. The weather was bad and uncertain, but there was some sunlight, and some interesting and definite results were obtained.

Bottles containing equivalent proportions of a sulphuric acid solution and potassium iodide were fixed in cases and exposed simultaneously to the sun and snow; some bottles were coated with pigments, others with cloth of various colors, but each case contained also some of the solution in an uncovered bottle as a control experiment.

The results were expressed in iodine equivalents, and they appear, he says, as Mr. Travers expresses it, "to indicate that the actinic value of the reflected light from snow is somewhere about 0.7 to 0.8 of the value of the direct rays of the sun."

The X ray plate exposed to the sun displayed skiagraphs of a piece of tin, whereas on the plate exposed to the snow no change could be detected; but as there are reasons for the possibility of this plate having been spoiled, this experiment was not conclusive. The author quotes Mr. Travers, in his remarks on the experiments, as follows:

"In dealing with the published accounts of the cases of sunburn and dermatitis produced by the so-called X rays, it is not at all certain that the injury done

to the hands and arms of the operators was due to the rays which are capable of penetrating aluminum sheets, etc. We know that the radiations from a Crookes tube include rays which come within the visible portion of the spectrum, and it is to these rays that we may attribute the power of producing sunburn.

Further, while it takes a very long time to produce sunburn in the neighborhood of a tube which will fog a photographic plate, contained in a dark slide, in a few seconds light reflected from the snow will sunburn in a very short time, but will not fog a plate in a dark slide.

"In a paper which appeared either in the *Lancet* or *British Medical Journal* a few weeks ago, it was shown that the effect produced by certain kinds of light—e. g., light from incandescent gas or arc lamps—produced injurious effects. The injury could not be attributed to the presence of a greater intensity of ultra-violet or violet light than was present in sunlight, but was due to the absence of 'red' radiation.

"In the reflected light from snow the heat rays are nearly entirely absent. The violet (chemical) rays would be present with almost the same intensity as in the direct sunlight.

"Considering the lack of evidence in favor of the X rays pure and simple being a cause of dermatitis similar to sunburn, it is worth while reviewing the facts in support of the theory that the true cause is to be found in the violet or chemical rays, or in the increase of intensity of the violet rays with regard to the intensity of the red rays.

"I think that the facts cited in your paper (*British Medical Journal*, March 7, 1896) furnish sufficient support."

Here, continues the author, from an entirely physical point of view, Mr. Travers, like others, arrives at conclusions similar to his own, namely, that the vital changes on the skin are due to the chemical rays, and apparently to those rays alone, and that the rays issuing from a Crookes tube are not an entirely new form of energy distinct and separate from light, but contain a proportion of luminous and chemical rays, and that light, as such, as well as the divisions into which it can be split up, may penetrate wood, clothing and the human tissues.

Dr. Bowles refers to Dr. Unna, who, in 1885, dealt very fully with the subject of pigmentary changes in the cutis, and suggested that they depended on the effects of the chemical rays, and that curcuma and colors acting on the light rays would prevent changes taking place. He refers also to an excellent paper by a Dr. Hammer of Stuttgart entitled "The Influence of Light on the Skin," in which the author deals with the subject first biologically; for example, the action of light on worms and other sightless creatures influenced by light through the skin. On the physical side he quotes the experiments of Terrier, Malakoff, and Widmark. From the beginning to the end, Dr. Bowles says, he found Dr. Hammer's work entirely corroborative of his own, but thinks that Dr. Hammer is not sufficiently impressed with the important fact that reflected light burns much more rapidly than direct.—*New York Medical Journal*.

THE ELECTRIC LIGHT IN RHEUMATISM.

Dr. KOZLOVSKI, a St. Petersburg physician, publishes in the *Vrach* an account of his method of treatment of rheumatism and neuralgia by means of exposure to the electric arc, says the *English Electrical Engineer*. He was induced to make these observations by the statement of Dr. Ewald, who is medical officer to some large ironworks, that he had noticed that since the introduction of the system of electric welding there had been a notable diminution in the number of cases of rheumatism, neuralgia, migraine, and other nervous diseases among the workmen, which he attributed to the beneficial effect of the electric light. In order to bring this therapeutic agent within the reach of ordinary patients, Dr. Kozlovski has fitted up consulting rooms with a suitable plant for producing the electric arc, which consists of a 6 horse power oil engine, a dynamo, 35 Tudor accumulators, a rheostat, ammeter, and electric arc lamp with reflector. With these he obtains an E. M. F. of 50 or 60 volts and a current of from 250 to 300 amperes. The patient is placed at a distance of 1½ meters from the light and protected by blue spectacles and also by a screen of cardboard in which an aperture is cut to allow the light to fall on the affected region of the body. To this it is exposed for from three-quarters of a minute to two minutes. At the time the patient feels a slight sensation of heat, though the temperature is never raised more than 4° F. where the light falls on the skin, but nothing more until six or eight hours afterward, when itching and tingling are felt and the skin becomes reddened. Some 48 hours later desquamation occurs, which lasts for two or three days. In the course of three months Dr. Kozlovski has treated 38 patients, varying in age from 13 to 70 years, by the electric light. There were eight cases of sciatica, all of which recovered; four of neuritis (locality not stated), two of which recovered; 18 of chronic rheumatism, 14 of which recovered; and three of lumbago, all of which recovered. In most cases three or four sittings produced an amelioration of the pain. They were continued at intervals of three or four days, according to the amount of cutaneous irritation, but the total number of sittings never exceeded a dozen. This extract we culled from the *Lancet*, and are glad to note that as the electric welder was developed by exaggerating the faults of a transformer, so the ill effect of the rays from the welder has some compensating good properties. We suppose that shortly the electric lighting station will be dispensing two minute doses of strong arc light to rheumatic consumers.

It appears that the trade of Marseilles has been decreasing for some time past. In 1891 the total import and export business of that large Mediterranean port amounted to 2,045,800,000 francs. In the following year it decreased 198,000,000 francs, and in 1893 the falling off against 1891 was nearly 280,000,000 francs. In 1894 and in 1895 the decrease was rather less marked, but in 1896 it amounted to no less than 282,000,000 francs. The Marseilles trade has accordingly lost, on an average, 250,000,000 to 300,000,000 francs per annum, or one milliard—200,000,000 francs during the six years from 1891 to 1896.

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TABLE OF CONTENTS.

	PAGE
I. ARCHEOLOGY.—Address by Sir JOHN EVANS.—A continuation of the address of the great anthropologist.	18002
The Story of the Philadelphia Expedition.—Explorations of the University of Pennsylvania in Babylonia.—A review of "Nippur: or, Explorations and Adventures on the Euphrates"	18001
II. BIOGRAPHY.—Edward Drinker Cope, Naturalist.—The conclusion of this interesting biographical sketch.	18002
III. BOTANY AND HORTICULTURE.—Aristolochia Goldiana.—1 illustration.	18001
IV. ELECTRICITY.—Electric Traction at Paris.—A description of a new method of electric traction in Paris, working by accumulators.—3 illustrations.	18004
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